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## ELECTRIC AUTOMOBILES.

A census is being taken of the central stations of the country by *Electrical World* as to the extent of their development of, or interest in, electric automobiles as a field of current consumption and as a branch of electrical industry that self-interest should prompt central-station managers to encourage. The blank forms to be filled up with data have only been out a few days, but we are surprised and pleased to be able to state that we have already received a little over 1000 returns. A much larger percentage has gone into the matter than is generally supposed. When more returns are in, we shall digest and publish the information; and, meantime, we would earnestly request our central-station friends to fill up the schedules promptly or express their views on the subject and forward immediately to this office in the return-stamped envelope provided.

## THE BOSTON LIGHTING SITUATION.

As our readers are already aware, Boston has been the scene during the past few months of interesting and somewhat sensational experiments on the improvement of street lighting, experiments carried on both by the Edison Electric Illuminating Company, which was getting ready to renew its lighting contract with the city, and by the Consolidated Gas Company in an endeavor to make a last stand against the invasion of improved illuminants. As a general rule, local controversies between gas and electric-lighting companies over the street lighting contract involve no broad issues, but in this instance the struggle which has just been closed by the awarding of the lighting contract to the Edison Company has been somewhat unusual, and involves technical matters of so general an interest as to make the situation of far more than local importance.

Up to the present time Boston has been lighted under contract between the city and the Edison Electric Illuminating Company by direct-current series enclosed arcs of the type devised by the late Mr. Gilbert, of the Boston Electric Light Company, the arcs taking about 500 watts at 6.7 amp. These lamps are equipped with clear outer and clear inner globes, and have been decidedly the most powerful enclosed arcs used for street service in this country, being customarily worked at a consumption of energy larger than that applied to similar lamps elsewhere. For the last year or two, as we have frequently pointed out, the tendency abroad has been strong toward the use of flaming or luminous arcs for street lighting, with a consequent great increase of the available light on the street; and it has been clearly evident that the enclosed arcs in common use in this country would sooner or later have to be displaced by the more efficient type. Understanding this fully, the Boston Edison Company prepared to take the initiative and to introduce high-efficiency arcs on a large scale at the time of the renewal of its contract with the city. It therefore caused to be made a very exhaustive investigation of street lighting abroad, obtained a large number of samples of foreign and American

lamps, and instituted a careful investigation of their suitability for street lighting.

Meanwhile, the gas company taking alarm at the inroads of tungsten street lamps upon its Welsbach service, determined to carry the war into Africa, and sent representatives abroad who imported a number of double inverted mantle Graetzin street lamps, working at the ordinary gas pressure, and also a large and flamboyant example of "press" gas lamp. It obtained permission to put out the former on an experimental section of street, and hoisted the latter in front of its own office. Meanwhile the Electric Company swung out a circuit of 6.6-amp magnetite arcs equipped with the latest type of luminous electrodes, and in addition, illuminated Copley Square and one or two other important locations with huge flaming arcs of unprecedented power, the results naturally being extremely striking. Up to this point the competition had been along dignified lines, but when it became evident that the exhibit of street gas lamps was a failure, and that the contract would inevitably go to the Electric Company, the controversy entered in an acute stage. The Boston papers for the last two weeks have been full of promiscuous abuse, first of the proposed installation of street lighting, and second, of the Mayor and other city officials. The row culminated when the contract was awarded to the Electric Company on the basis of the magnetite and flame arcs. The magnetite arcs in question were accepted by the city at the price of $103.54 per year each, which for a lamp having more than double the illuminating power of any street lamp ever regularly used before for public lighting in this country, is a remarkably low figure. For the few Gilbert arcs which are to remain for the present, the price was brought down to $92.31 per year, while for the few flaming arcs installed in large public places, the price figured was $156.27. Each of these lamps replaces three ordinary arcs. The contract was for five years, and the attacks made on it have seemed to be based, not upon any doubt as to the quality of the service nor seriously upon any question of price, which latter for the illuminants furnished will be recognized as low by anyone competent to judge.

The extraordinary feature of the situation and the one which most calls for comment is that, at the present time, in face of the technical facts which ought to be well known, any portion of the public should be found willing to advocate the reversion to gas for street lighting in place of luminous arcs and tungsten series lamps as now used. In point of fact, while the Graetzin street lamps on which the Gas Company intended to rest its case were rated by the makers at 250 cp and were loudly advertised as of that capacity, they were actually found to give on the street barely over 100 cp at an angle of, say, 25 deg. below the horizontal. They were repeatedly tested by Professor Puffer, the expert called in by the city for guidance in making its new contract, by the Electrical Testing Laboratories, and by various private observers, and always with the concurrent result that the candle-power they gave was less than half that which they were alleged to give. In a precisely similar manner the huge "press" gas lamp, which flared in front of the Gas Company's office and which was heralded as of 4500 cp, was tested by various independent authorities and uniformly found between 2000 cp and 2400 cp. The disclosure of this grossly incorrect rating naturally discouraged the city from wasting any further time in experimenting with gas, and doubtless contributed to the prompt settling of the controversy. Under the new contract Boston will be equipped with by far the most powerful lights ever used in America for public lighting; and inasmuch as the old spacing of the arcs is to be retained and the new lamps are to be placed for the most part 25 ft. above the pavement instead of 19 at present, the result will necessarily be a brilliancy of illumination which is for once something like that which a first-class city owes to its citizens. We hope it will be the opening of similar changes for the better all over ernment of Boston is to be congratulated on being first in line the country. The time is ripe for the change and the city govdespite the efforts of a misguided element to block progress and to revert to methods nowhere strikingly successful and generally discredited.

## An Unfavorable Experience with Metallic-Filament Lamps.

The description in an article printed elsewhere by Mr. Warren H. Miller of his persistent struggles to use high-efficiency lamps in a big oil plant is a highly interesting, if somewhat discouraging, tale of woe. In brief, Mr. Miller's experience shows wholesale destruction of both tantalum and tungsten lamps when exposed to rough handling and vibration. His plant was operating at 25 cycles, and one might therefore confidently have predicted any amount of trouble in trying to use tantalum lamps which fault and get brittle after a very short time under such conditions. They will often run to a long life even on alternating current, if not subject to rough usage, but are in a condition that ensures breaking at some one of the scores or hundred of faults under any kind of shock. One may therefore dismiss the tantalum matter merely as an experiment which perhaps was worth trying, although presumably foredoomed to failure. The experience with tungsten lamps, however, was altogether more important, and one cannot help feeling that here Mr. Miller really played in rather hard luck, and as he went into it rather early, may have suffered from some bad batches of lamps, not yet fully eliminated from manufacture.

To sum up the economic results, of 1726 tungsten lamps placed in service between Oct. 2 and Jan. 26 last, only 389 were burning on April 2. Of this group it is worth noting that the 60-watt size seems to have shown the best results, although the dates and nature of the situations may have had some influence here. Of 550 60-watt lamps, 215 survived, while of 540 25-watt lamps only 30 pulled through. The 100-watt and 40-watt lamps did only fairly well, while of four 250-watt lamps purchased at $4.87 each, two were broken when received and one departed this life the first night of service, and the survivor was stolen in a few days. This $19.48 worth of experience seems to have sufficed Mr. Miller on this particular size. Now, if Mr. Miller's luck were unique, one would have little to suggest save more care, but others who have used tungsten lamps in rough industrial works have had similar troubles, though usually in less degree. The great efficiency of tungsten lamps, with their consequent large saving of current, is a temptation to their use even under difficult conditions, and many have taken the chance, so that it is little wonder that results have now and then been bad. It is undeniable that the tungsten filament as now made for ordinary voltage is brittle and liable to fracture on very small provocation. On the whole, however, it is getting better as time goes on, and, if rumor is correct, new processes are becoming available which may result soon in the production of a tungsten filament of great tenacity. It is to be hoped that this goods news is true, and that the makers of tungsten lamps will

be unable to hold back the process successfully, a step which commercial interests might urge.

In any event, it is pertinent to inquire whether anything can really be done with high-efficiency lamps under such circumstances as Mr. Miller describes. Of course, he found the graphitized-filament lamps all right as to life, but these cannot be taken seriously as of high efficiency in the sense of tantalum and tungsten lamps. It should in the first place be possible with the present resources in the way of reflectors to locate most of the lamps where they will not be actually hit by careless workmen. That precaution would remove one prolific source of damage. Next, the cleaning of the lamps when necessary should be in charge of some definite person, and the lamps should be lighted when cleaned. Finally, there should be systematic efforts at cushioned supports for the lamps. We believe that it is perfectly possible to develop a socket so supported as to cushion the lamps from shocks in a very complete manner. With lamps placed mostly out of reach on soft supports, shocks from vibration need not much be feared, and this gets rid of a constant source of mischief. In spite of the fragility of the ordinary tungsten filament, we believe that it is practicable to reduce very much the danger of breakage, so that industrial plants can get the benefit of the resulting economy. Then as a last resort, one can come down to the use of 50-volt to 60-volt tungsten lamps with special transformers. It seems to be thoroughly demonstrated that these low-voltage lamps are much stronger and of far longer average life than those for standard voltages, and their use involves little extra trouble, especially in installations already wired for carbon lamps. In spite of Mr. Miller's rather discouraging results, we do not believe the industrial plant is cut off from the benefits of tungsten lamps by the fragility of the filaments. One must treat a lamp according to its characteristics, and if it be intrinsically fragile one must take advantage of every device that will help in safe installation. Even the tantalum lamp, tender as it is under alternating current, could be cushioned so as to increase its life, and the tungsten lamp, particularly at low voltage, can certainly be made thoroughly available.

## The Testing of Live Cables.

A paper has recently been read before the Dublin section of the British Institution of Electrical Engineers by Mr. R. G. Allen on "Testing the Insulation Resistance of Live Cables on Direct-Current Systems." The paper describes methods suitable for measuring the insulation resistance of mains, submains or house-wiring systems, when the lamps or motors are cut off, but when the full working pressure of, say, 440 volts is applied. The advantage of such testing methods is that they are conducted under service conditions and without the necessity either of cutting the tested mains off the system or of carrying about a testing battery. In low-tension, direct-current distributing systems the insulation of the various conductors is of importance when the neutral is ungrounded. At any moment a ground coming on one side of the system may change the pressures on the insulation of the system. If, for example, the system is running with a balance of distributed leakage, the neutral conductor will be at zero, or ground potential, the positive conductor will be at, say, 120 volts positive, and the negative conductor will be similarly at 120 volts negative potential. Should now a heavy ground come on the negative side of the system, the potential of that side will suddenly be brought to zero, the potential of the neutral to 120 volts positive and the potential of the positive to 240 volts positive. In this manner a sudden change of grounding from one side of the system to the other will throw the pressure from one set of conductors to another in a manner that is likely to give rise to sudden faults and leakages in house wiring, at times, perhaps, when no person may be at hand to notice and protect them.

In low-tension, direct-current systems operated with grounded neutral, the pressure on the neutral conductor throughout the system is always zero, that on the positive will always be 120 volts plus, and that on the negative 120 volts minus. If a ground breaks out on either outside system, it will immediately determine a rush of current through the same. Inside a building, the ground will produce a current rush to cut out the faulty wire through the melting of a fuse. In a street main the ground will probably produce a current rush sufficiently violent to burn off the ground. The insulation resistance of house wiring in such a system will be worth measuring from year to year as a matter of inspection, and the insulation of positive or of negative mains, at regular intervals, will be worth recording as a matter of inspection routine; but the importance of frequent insulation tests is usually very small. In high-tension, alternating-current cable systems the case is different. Except in the unusual case of sudden mechanical injury, these cables ordinarily break down electrically after undergoing a fairly steady depreciation. The fall is generally preceded by a steady decline. It becomes important, therefore, to keep constant watch for such decline, in order to remove the faulty cable from service before breakdown occurs. When breakdown takes place, it may entail surges of potential in the system sufficient to create new defects in cables that might otherwise have carried their pressure indefinitely. Leakage indicators are, therefore, frequently installed on high-tension feeder cables at their switchboard terminals. These indicators are frequently electrostatic devices arranged to point to safety if the potentials of the conductors in the cable are equally remote from ground, but to point to danger if the potentials become unbalanced and dissymmetrical. Such insulation tests are, therefore, continuously maintained on the live conductors, without entailing any considerable expense, and without involving any loss of power in the process.

## The Efficiency of Light Production.

A recent paper before the London Physical Society by Dr. Drysdale takes up the possibilities of efficient production of light by true black-body radiation, the result being based on Wren's law in connection with the experimental results of Kurlbaum and others. The essential point of the investigation is the limited possibility of high efficiency from illuminants of pure incandescence. This has, of course, often been recognized as a matter of practice. By utilizing Féry's results, Dr. Drysdale finds 0.075 watt per candle-power as the theoretical so-called "mechanical equivalent of light" on the incandescent basis. This is fairly in accord with similar estimates and as a practical matter is not particularly encouraging, since the temperature indicated for maximum luminous efficiency runs to about 6500 deg C.—i. e., somewhere in the vicinity of solar temperature. Since no known substance is available for incandescence at anything remotely resembling this figure, the chance of improvement in any great degree would seem to be somewhat remote so long as incandescence of black bodies is concerned. In passing beyond 2000 deg. C., however, the efficiency rises very rapidly, as witness experiments with tungsten lamps at very abnormal voltage. Results with the electric arc are, of

course, rather inconclusive, the light production being much interfered with by the usual construction of the apparatus and only a part of the energy being available for incandescence even at the maximum crater temperature. The color values of the best incandescent lamps show how far their efficiency falls below that of the luminous crater, and the intrinsic brilliancy tells the same story. In the arc itself the difference between the phenomena at the two electrodes is a clear indication of the limitations of present apparatus. Even the most powerful carbon arc of the intensive type falls very far short of giving light at anything like theoretical efficiency.

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It seems quite clear then that the greatest chance for improvement lies in such selective radiation as is given by incandescent gases and vapors, in, for instance, the luminous arcs. As a matter of experiment, the most efficient of the flame arcs can be driven to an efficiency within easy hailing distance of the black-body maximum, though at the cost of ill-balanced color. The great problem for such illuminants is to balance the color as well as may be without too great loss of efficiency. To be sure, in many cases—street lighting, for example—color within limits is a matter of minor importance, but, broadly, it cannot be neglected. Another line is indicated, even if only roughly, by Dr. Hyde's recent work on the variations of some incandescent metallic filaments from the "black-body" law. These variations are somewhat uncertain owing to the doubt about the real temperatures of the filaments, but they are nevertheless suggestive. On general theoretical principles it seems unlikely that any very great variations of such kind will be found save in connection with a condition of physical or chemical instability, so that the limitations of efficiency are rather likely to be found embarrassing. Selective radiation and selective absorption go hand in hand, and the latter rather implies destructive energy in one sense or another save perhaps in the case of fluorescent bodies, which seem to be quite outside the range of other properties required. As to incandescent gases by themselves, the outlook for efficiency is not very striking since the energy distribution of their spectra is not generally very favorable, as, for instance, in the case of helium. Beyond these one meets the vague range of possibilities furnished by the firefly, luminous bacteria and the like. This field is as yet practically unexplored, since almost nothing has been done in the direction of finding out the actual character of the radiation concerned. Until this is done one is quite in the dark as to the possible limitations of efficiency. The work of Langley is about the only basis even for a guess, and, to tell the truth, one cannot read his work on firefly light without a certain vague, although perhaps unjustified, feeling that it ought to be very carefully repeated. The spectrum he records bears too close a resemblance to an ordinary continuous spectrum of extremely low intensity for the similarity to pass unnoticed. Altogether, the outlook for anything very sensational in the way of chemical light can hardly be considered brilliant at the present moment. The best road to high efficiency seems to be via the flaming arc. Much can be done along this line, and a complete search among the metals and their refractory compounds should be made. In fact, it is being made in various places with some results that look fairly promising. In small light units one must for the present look to the improvement of the tungsten filament in the direction of a nearer approach to a stable wire, an improvement perhaps much nearer than is generally suspected.

## The City Electrical.

When one reckons up all that has been done in the applications of electricity to human affairs and realizes the short span of years in which all the wonders have been accomplished, his bosom swells with pardonable pride if he does not think about the matter too long. Further contemplation is not altogether good for the soul, for soon there rise before the eyes very unwelcome visions of things that ought not to be—locomotives belching smoke and cinders along the byways of the city; hundreds of factory chimneys reeking with the fumes that only man of all creatures has really learned to tolerate; thousands of lesser filthy chimneys adding their mites to the noisome whole; sundry flickering gas lights in most of the dwelling places, and like as not, evil savored coal oil lamps and guttering candles. All these offend the sight and smell and bring a most unpleasant realization of the manifold things that electricity has not done to ameliorate human life. In spite of all the activity with which central-station work has been exploited it still is very far from filling its sphere. True enough, it has pretty nearly driven horse cars from the streets and it has replaced gas to a considerable extent among the larger consumers; it has replaced, too, some gas and steam engines in the smaller factories and has robbed the denatured alcohol industry of a few chafing dishes and curling tongs—but the bigger things that make for cleaner homes and streets and skies it has as yet been unable to touch in any effective way.

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Why should not it enter this wider sphere and directly or indirectly get at the vital problems it contains? To begin with, why should not practically all the steam engines in urban territory be superseded by electric motors? Of the thousands of engines operated in any large city, nearly all would be economically replaceable by electric motors at quite possible prices for current. Is it not feasible to get them replaced by a sufficiently thorough campaign? More than this, if the usual urban regulations against smoke were really enforced, would not most of the steam engines have to go anyway? At present the central stations for the most part cannot reach far down enough in price to get all this business, yet with the opportunity to get it all, the matter of price would settle itself. Of course, if the central station rates are regulated to petty things by ignorant supervisors not much can be done. Is not a problem of this sort, however, within the scope of civic leagues and other organizations that undertake municipal reforms? Should not their influence be thrown toward the abolition of the smoke nuisance by giving the central stations a helping hand in their campaign for better things? And why should not the same influences work for the prohibition of the steam locomotive in every large city as it has been prohibited in the New York terminals? Granted all this, there would still remain the huge heating problems. At present prices for electricity, electric heating on everything but a small scale is handicapped. If, however, vastly greater output were possible a price might be made that would very much widen the field.

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When it comes to heating indeed, one may perhaps look for bigger usefulness than has ever yet been realized. Could one turn over to electricity all the lighting and the bulk of all the motive power, it should be possible to put out for the remaining work a fuel gas at a price that would make its use practicable on a very large scale indeed. Perhaps such may

be the future of the great gas industry—to work hand in hand with electricity to make a city what it ought to be. If it were feasible, as indeed it may be, to make the production of electricity co-ordinate with that of gas in the same works, it would be possible to clean up all the activities of a great city at once. One huge station, located where the prevailing winds would drive its smoke seaward or dissipate it, could be made adequate not only to furnish electricity but fuel gas, the one being in a sense the by-product of the other. A coke plant utilizing in changeable proportions its solid and gaseous products for motive power and for fuel gas, could be made to have a wonderful load factor and ought to turn out its joint products at figures hitherto unknown. With such a source of supply for all its needs, a city would become a new world. Fancy, for instance, New York or Chicago with the clear air of a country village! Yet such a change is not at all a dream impossible of realization unless one charges up failures to perverse human nature. Physically, the situation is an entirely possible one, and there are those now living who may survive to see it. It certainly is worth a struggle. Until such a condition is brought about he is reckless who thinks that electricity has even approached the bounds of its development.

## Ground Return in Power Transmission Circuits.

It is recorded that Steinheil nearly a hundred years ago, in experimenting with his telegraph system, hit upon the idea of using the two iron rails of a railway track for the going and return conductors of a telegraph circuit. To his surprise and dismay, he found that the practical range of working in this manner was most limited. On following up the attempt with investigation, he found that the current leaked across from one rail to the other through the ground. This idea dawned on the experimenters of that time as a new conception, although in this age it is so familiar to our minds as to seem well-nigh intuitive. Steinheil won satisfaction, however, from his disappointment by making the ground return available, and by thus making a single telegraph wire the equivalent of the two conductors theretofore employed. Ever since the date of that discovery, the telegraph circuits all the world over have used ground return. There have been occasional troubles in making satisfactory ground, but, in general, the result has been all that could be wished.

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On the advent of the electric lighting circuit of low potential an effort was made to get into the same boat with telegraphy, and to use the ground return. The attempt was, however, given up as impracticable after a few failures, owing to unduly large resistance in the ground circuits. The nearest approach to the use of the ground return in electric lighting distributing circuits is found on board some ships, where the steel hull of the vessel is used as a common return conductor, and in some three-wire systems whose neutrals, grounded in several places, may incidentally determine a small current flow through the earth. For all practical purposes, therefore, electric lighting has resigned all claim to the ground in distributing circuits. When telephone circuits were first introduced another endeavor was made to share with telegraphy in the benefits of the ground, in order to simplify the lines, and to carry but one wire to each subscriber. After years of vain struggle with electric disturbances of various kinds, the telephone had to give up the unequal contest, and to shelter itself by doubling its wires in all directions. Except for signaling and auxiliary purposes, telephone lines are now nearly all metallic circuits. On the arrival of the electric trolley circuit, once more the earth was laid under requisition for a return circuit, with the track rails aiding for what they might be worth. Here it was argued the drop of voltage in ground resistance was not of any great importance, and the saving in conductor would be most notable. After a few years, electrolytic troubles began to manifest themselves, in cities, to such an extent that at the present time good urban practice virtually disuses the ground return, and brings the current back to the central station almost wholly on ground cables, with the aid of elaborately bonded rails. Within the last few years the high-tension, alternating-current railway system has started on a new campaign of owning the earth, and again the telephone man and the telegraph man are up in arms with complaints of widespread electric disturbances on their circuits near its path.

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In connection with the above question some interesting experiments have recently been published in *La Revue Electrique*, and were reported to the Electrical Congress of Marseilles last year. The experiments were made on the resistance of the ground to strong direct currents, both in France and in Switzerland. In the French experiments a direct current of 210 amp was led to ground, made of a number of cast-iron pipes passing into moist soil. It was found that the drop of pressure in the ground return was 360 volts, and that the resistivity of the soil appeared to be 6600 ohm-cm—that is, a centimeter cube of soil averaged 6600 ohms between any pair of opposed faces. In the Swiss experiments use was made of the Thury direct-current transmission system which runs from St. Maurice, at the Rhone Falls, to Lausanne on Lake Geneva. A direct current of 150 amp was carried between Bex and Lausanne over one of the transmission lines with ground return. The resistance of the ground at Bex was measured as 0.83 ohm, and that at Lausanne 0.7 ohm. Evidence is cited in the paper to show that the ground at Bex is limited to some extent by the neighboring Alpine ranges of fairly non-conducting material, so that the lines of equipotential on the ground surface due to the return flow are markedly distorted by these semi-insulating barriers.

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The experiments confirm satisfactorily the existing theory of the part played by the earth's crust in the ground return circuit. According to this theory, the resistance of a good ground is mainly encountered within a comparatively short distance from the ground connection. Within a radius of the first 100 m some 90 per cent of the ground's resistance will have been encountered, and within a radius of the first kilometer, practically all of the resistance will have been passed. Consequently, it makes practically no difference whether two good grounds are 2 km or 2000 km apart, the resistance between them will be the same for all practical purposes. Incidentally, the experiments indicate that it may be possible in the future to learn something about the electrically conducting nature of deep-seated rocks by studying the distribution of electric potential on the ground's surface during the flow of powerful direct currents between ground plates widely separated. Such observations might perhaps entail geological deductions of some importance.

## A. I. E. E. Annual Convention.

Following is the preliminary program of papers to be presented at the annual convention of the American Institute of Electrical Engineers, to be held at Hotel Frontenac, Thousand Islands, beginning Monday, June 28, 1909:

1. Some Considerations in Designing Heavy-Capacity Fuses, by Mr. L. W. Downes.
2. A Sketch of the Theory of the Adjustable-Speed, Single-Phase Shunt Induction Motor, by Mr. F. Creedy.
3. Calculation of the High Tension Line, by Mr. Percy H. Thomas.
4. Transmission paper, by Mr. W. S. Moody.
5. Effect of Frequency Upon the Cost of Alternators, by Mr. C. J. Fechheimer.
7. Two papers on high-tension transmission subjects, by Mr. R. D. Mershon.
8. The Reduction in Capacity of Induction Motors Due to Unbalancing in Voltage, by Messrs. S. B. Charters and W. A. Hillebrand.
9. The Heating of Induction Motors, by Mr. Alexander M. Gray.
10. Telephone paper, by Mr. J. J. Carty.
13. Three industrial power papers, by Mr. D. B. Rushmore.
15. The Resistance and Reactance of Armored Cables, by Mr. J. B. Whitehead.
17. Two educational papers, by Messrs. A. S. Langsdorf and H. J. Ryan.
18. Generation for 100,000 Cycles, by Mr. E. F. Alexanderson.
19. Repulsion Motors with Variable-Speed Shunt Characteristics, by Mr. E. F. Alexanderson.
20. Auxiliary Poles for Direct-Current Machines, by Mr. John N. Dodd.
21. The Thermal Convection from Thin Copper Wire Supported in Air, by Dr. A. E. Kennelly, Mr. C. A. Wright and Mr. J. S. Bylevelt.
23. Two papers by Comfort A. Adams.
24. Harmonics, Even and Odd, by Mr. J. B. Taylor.
25. Electric Measuring Devices, by Mr. L. T. Robinson.

## Annual Convention of Southwestern Electrical & Gas Association.

The preliminary program of the fifth annual convention of the Southwestern Electrical & Gas Association, to be held at Dallas, Tex., May 20, 21 and 22, indicates that the meeting will be one of unusual interest. As in the case of several of the Western electrical associations, space for exhibits of apparatus will be supplied free of charge, the only expense to an exhibitor being for electrical energy, if any be used. Arrangements have been completed for special railroad convention rates.

An excellent entertainment program has been provided. On Thursday, the first day, there will be an automobile ride for visiting ladies, a luncheon at Lake Cliff for all attendants and in the evening a theater party. On Friday there will be a luncheon at the Country Club for ladies, and also an entertainment in the evening. On the same evening the Sons of Jove will provide an entertainment for all of the other sex in the form of a grand "Rejuvenation." On Saturday there will be visits to public-utility plants and other points of interest in Dallas. Following is a list of the papers to be presented:

"Producer Gas Plants for Small Central Stations," by Mr. W. B. Head, Stephenville; "Scope of Legal and Claim Departments and Their Relation to Each Other," by Mr. H. S. Cooper, Galveston; "Organization and Operation of a Claim Department," by Mr. W. C. Forbes, Ft. Worth; "Lamps for Residence Illumination: Their Characteristics and Comparative Economy of Operation," by Prof. Arthur Custis Scott, Austin; "Low-Pressure Turbines," by Fred M. Lege, Jr., Galveston; High-Pressure Gas Distribution for Commercial Purposes," by Mr. H. M. Moore, Austin; "A Method of Determination of Total Sulphur in Gas," by Mr. L. B. Morehouse, San Antonio; "Preparation of Purifying Material, and the Purification of Gas," by Mr. Clark F. Farmer, Austin; "Economies That Can Be Made in the Operation of a Small Central Station," by Mr. Thos. Cook, Waxahachie.

Mr. D. G. Fisher, 300 Commerce St., Dallas, Tex., is acting secretary of the association.

## Boston Street Lighting Situation.

Mayor Hibbard, of Boston, has signed a contract for the street lighting of the city for five years by the Edison Electric Illuminating Company, after exhaustive consideration of the relative possibilities of electricity and gas. The matter has been under investigation for many weeks and keen competition has been manifested between the Edison Company and the Boston Consolidated Gas Company. About 3500 lamps are involved, and the rate of payment by the city is $103.54 per lamp per year for magnetite arcs of 475 to 550 watts each (6.6 amp), and $92.39 per lamp per year for not exceeding 500 enclosed arcs of the so-called Gilbert type, 475-550 watts. These rates are on a basis of a fixed charge of $42 per lamp per year for the magnetites and $36 for the Gilberts. The running charge on the magnetites is figured at 1.75 cents per kw-hour and on the Gilberts at 1.6 cents per kw-hour. The Edison Company is to substitute magnetite lamps at not over 100 per week for the Gilberts. Rates are also quoted on 40-cp, 60-cp and 80-cp incandescent lamps at $19.35, $22.31 and $27.85 per year, according to the company's regular schedules. The total costs are based on 3828 hours per year burning. The contract contains a provision for arbitration of cost by the head of the electrical departments of Harvard University and the Massachusetts Institute of Technology, on request of either party. The duration of the contract may be extended to a period of 10 years by agreement of the parties. The contract amounts to about $350,000 per year.

As a result of various criticisms on the action of Mayor Hibbard in signing the street-lighting contract at the present time with the Boston Edison Company, the Mayor has made public the report of Superintendent of Streets Guy C. Emerson, showing in detail the reasons for the selection of electricity instead of gas. Mr. Emerson is an engineer of wide experience, and his recommendation in favor of the Edison Company was the result of an exhaustive investigation of the possibilities of both gas and electricity, including tests and cost comparisons over an extended field.

Mr. Emerson states that the previous contract for street lighting in Boston was made in 1894, for a five-year term, and in 1898 this contract was extended for 10 years. The original price for the so-called "Gilbert" or enclosed series arc under this contract was $127.75 per year. In 1906 this was reduced by arbitration provided for in the contract to $118.39. This last price is what the city has been paying up to the making of the new 1909 contract.

In his study of the problem Superintendent Emerson visited the various large cities along the Atlantic seaboard, collected information from both domestic and foreign sources, and called various persons into consultation. The results indicated that the tendency of the times is toward what might be termed spectacular lighting, or a more brilliant illumination for the streets. The Boston Edison Company offered to demonstrate any lamp, either of foreign or domestic manufacture. A number of lamps were submitted, from which the present General Electric flaming-arc and its 6.6-amp magnetite-arc lamp were selected as the basis of the new contract. The magnetite was regarded with special favor on account of the brilliancy of its light and the character of illumination given. The flaming-arc lamp was considered as a very valuable lamp for large open spaces, to be used in very limited numbers. In November, 1908, there were 24,189 magnetite lamps in operation in 80 cities and towns of the United States, and since then this number has been largely increased. Among the more prominent cities using these were: Baltimore, 1625; Fall River, 1000;

Toledo, 1800; Portland, Ore., 1725; Syracuse, 1500, and Worcester, Mass., 1000. These magnetites are lamps requiring but two-thirds the current of the lamp adopted for Boston, and of about one-third the illuminating power, being slightly superior in illuminating power to the Gilbert lamp used in Boston up to the present arrangement, but much more economical of current. The new Boston lamp is identical in material and construction with the above lamps, except in power. A number were tested in Boston street service, and in every case they fulfilled entirely the claims of their makers. As a result of improvements in the magnetite lamp, the city secured a price of $103.54 per lamp per year, based on 3828 hours burning, upon provision that all Gilbert lamps in excess of 500 should be replaced by magnetites. These magnetite lamps show by Mr. Emerson's tests about three times the candle-power in a given direction of the old Gilbert lamps. A price of $92.39 per lamp per year was made for the small number of Gilberts to be left. As this price took effect on April 1, and holds until the Edison Company can install the magnetite lamps, the city will receive great benefit from the reduction, the saving in April being estimated at over $8,300.

Mr. Emerson exhausted every avenue open in the attempt to find some form of competition with electricity for street lighting. Consultation with the Massachusetts Gas and Electric Light Commission, through the chairman, indicated that nothing was to be hoped for in the way of an appeal to force a lower price from the Edison Company. A thorough investigation was made of gas lighting in competition with electricity. Reports were gathered from various foreign sources, and several propositions were submitted by the Boston Consolidated Gas Company, notably for the installation of the so-called Graetzin low-pressure lamps and for high-pressure lamps in competition with the electric arc. An installation of Graetzin lamps was made in Commonwealth Avenue, and one high-pressure lamp was installed in front of the gas company's office on West Street. Frequent tests of the Graetzin lamp convinced Superintendent Emerson of its efficiency and its value as a possible competitor with the Welsbach low-pressure lamp; but its candle-power was found to be less than half the amount claimed by the gas company. Mr. Emerson finds that in general the city's Welsbach lamps, which are guaranteed for 60 cp, do not average much above 40 cp. It was also found that the Graetzin lamp was extremely susceptible to weather conditions. This lamp was therefore eliminated from consideration in connection with the contract. Superintendent Emerson's report states that the proposition of President Richards, of the Boston Consolidated Gas Company, dated April 5, for the installation of pressure lamps of the gas type is so vague regarding the character of the lamp as to be of little practical value, and verbal interviews with President Richards did not tend to throw more light on the subject. In regard to the statement of Mr. Richards that "the ordinary type of gas street lamp" gives about 20 cp per cubic foot of gas, Superintendent Emerson replies that his tests show that the present Welsbach lamps give approximately 13 cp per cubic foot of gas, and the Graetzin lamps installed by Mr. Richards' company, less than 15 cp. Tests of the single high-pressure lamp installed on West Street show that the candle-power per cubic foot of gas is about 30, instead of 73, as Mr. Richards states. Mr. Emerson then states that the 80-cp tungsten lamp for $27.85 per year, which actually gives the rating attributed to it, is more powerful than the Graetzin lamp, and at a considerably lower price. Between Arlington and Berkeley Streets, Boston, 16 Graetzin lamps at $35 each gave a total candle-power by test at 20 deg. from the horizontal of 1600, at a cost of $560 per year, or 2.85 cp per year for $1. Five magnetite lamps, between Berkeley and Clarendon Streets, at $103.39 per year, gave a total of about 7500 cp at a cost of $515 per year, or 14.6 cp per year for $1.

STREET ARC LAMPS.

| | Lamp and Watts. | Hours per year. | Price per year. | Price per kw-hr. |
|---|---|---|---|---|
| Boston | 500-watt D. C. | 3828 | $92.39 | 4.8 |
| | 6.6-amp. Magnetite | | 103.54 | 5.4 |
| Fall River | 4-amp. Magnetite | 3900 | 91.25 | 7.3 |
| Cambridge | 425-watt A. C. Enc. | 3900 | 90.00 | 5.4 |
| Brooklyn | 450-watt D. C. Enc. | 4000 | 100.00 | 5.6 |
| Brookline | 500-watt A. C. Enc. | 3828 | 124.10 | 6.2 |
| Chelsea | 425-watt A. C. Enc. | 3828 | 100.00 | 6.2 |
| Haverhill | 450-watt D. C. Open | 4000 | 100.00 | 5.8 |
| Lawrence | 450-watt D. C. Open | 4000 | 90.00 | 5. |
| Lowell | 500-watt A. C. Enc. | 4000 | 100.00 | 5. |
| Lynn | 500-watt A. C. Enc. | 4000 | 94.90 | 4.7 |
| New York | 450-watt D. C. Enc. | 3950 | 100.00 | 5.6 |
| Pawtucket | 425-watt A. C. Enc. | 4000 | 112.50 | 5.6 |
| Philadelphia | 450-watt D. C. Open | 4100 | 94.00 | 5.1 |
| Providence | 450-watt D. C. Open | 4013 | 104.75 | 5.8 |
| Woonsocket | 450-watt D. C. Open | 4000 | 146.00 | 8.1 |

Mr. Richards concludes with a tabulated statement of the present cost of street lighting per kw-hour in a number of representative cities. An examination of the rates in large Eastern cities discloses the fact that nearly a uniform schedule exists, modified only by conditions such as the price of coal, labor, and the investment in underground construction. The table is shown herewith.

## Hydro-Electric Development at Ox Bow Bend, Snake River.

The Idaho-Oregon Light & Power Company furnishes electricity to the cities of Boise, Emmett and Payette, Idaho. At Ox Bow Bend in the Snake River, 55 miles north of Huntington, Ore., where the topographical conditions are very favorable to water-power development, the company is building a hydro-electric generating plant, which is planned to produce electrical energy equivalent to 21,000 hp, measured at Boise, over 100 miles distant. The work of building the generating plant and hydraulic accessories is about half completed, and it is expected that the station will be ready for operation in about a year. The Arnold Company, Chicago, is doing the engineering, and J. G. White & Company, of New York, are doing the Ox Bow construction. Six per cent bonds amounting to $1,500,000 are offered for sale to defray the cost of power development. The net earnings of the company for the year 1908 are stated to have been $123,500.

## Proposed Limitation of Sale of Sanitary District Power.

The Kleeman bill to compel the Sanitary District of Chicago to offer its electrical energy first to municipalities at cost, as previously outlined in these columns, is still pending in the Illinois Legislature and has aroused the active opposition of the Sanitary District trustees. By insinuation the Commonwealth Edison Company has been pointed to as one of the forces behind the bill, but Mr. Samuel Insull, president of that company, denies this charge vigorously, saying that he knows nothing at all about the Kleeman bill and that it is high time that the officials of the Sanitary District ceased to hold the Edison Company before the people as a bogey. Mr. Insull declares that the passage or the defeat of the bill means nothing to the Commonwealth Edison Company.

The Sanitary District trustees seem greatly exercised at the prospect of the passage of this bill, which is intended to give the municipalities along the Drainage Canal the refusal of the power at cost before it is offered to private consumers. Mr. Wallace G. Clark, one of the trustees, is reported by the Chicago *Daily Tribune* of April 28 as having made a bitter attack on the bill in an address delivered before the City Club of Chicago. According to the *Tribune*, Mr. Clark said, among other things: "We have had men murdered on our lines. Take our big transmission line where we have thrown the line dead in order to put in necessary repairs, we have found that there are agencies who have gone on down the line and thrown a chain over it, killing the men on that line. The Sanitary District has no labor troubles, so you can draw your own conclusions in this matter, the same as the trustees of the district do." Considerable unfavorable comment has been caused by the serious nature of these insinuations, and whatever may be the fate of the Kleeman bill, it is generally considered that there is no excuse for going to such extreme lengths in endeavoring to oppose it.

## Long-Distance Operation of Waterworks.

Addressing the Chicago Association of Commerce recently, President R. R. McCormick, president of the Sanitary District trustees, made an interesting statement in relation to the utilization of electrical energy from the Drainage Canal hydro-electric power plant for the operation of municipal waterworks pumping stations. He said: "It was a hobby of mine, and I now concede that I was in error, that all the waterworks of Chicago should be operated by this same canal power, but it was pointed out by the city engineer in charge of the waterworks that in case of fire it would not be a safe thing to have the entire water supply dependent on one transmission line 30 miles long from Lockport, which might be destroyed by a tornado or by a violent lightning storm, or by mischief, thereby leaving Chicago at the mercy of the flames. So it has not been possible to attach the power house at Lockport with the pumping station in Chicago. I understand that a new station about to be erected will be partially equipped with electric power, so that part of it will be operated from Lockport and part of it by steam."

## Pennsylvania Electric Locomotives.

A dispatch from Pittsburgh states that the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company have received orders to begin the construction of the first lot of electric locomotives which the Pennsylvania Railroad Company will operate in the tunnels of the New York terminals. It is understood that these locomotives will combine the most desirable features of electric locomotive design as determined by the tests conducted by the company with locomotives of different types on the West Jersey & Seashore and the Long Island Railroads, and by the manufacturers at East Pittsburgh, which tests are stated to have represented the expenditure of more than $500,000. It is understood that the locomotives will be the most powerful electric locomotives ever built and will be of the articulated type, each locomotive to consist of two units. Each unit will be equipped with one 2000-hp, direct-current motor mounted above the frames and connected to the wheels by connecting rods and side rods. The locomotives will be able to attain a speed of 90 miles per hour, and the first two to be built will be ready for test in the early fall. The present order will consist of 24 double units, but more will be required soon after the terminal station is opened.

## Grounded Secondaries at Iowa Convention.

For several years past the Iowa Electric Association has had reports at its conventions on the grounding of secondary circuits. The importance and advisability of such grounding in order to protect lives of consumers had apparently been so well established that no discussion on this point was raised at the last two conventions, and attention was given exclusively to determining the best and most reliable form of grounding. The report of the committee this year, of which Mr. Thomas Sloss, of Cedar Rapids, was chairman, was made by Professor F. A. Fish, of Iowa State College, Ames, Ia., who said that it had not been possible to make tests on the resistance on different kinds of grounds during the past year. It was stated, however, that a part of the State engineering experiment station appropriation might be available for this the coming year.

The report contained an interesting letter from Dr. C. P. Steinmetz on the subject. Dr. Steinmetz stated that grounds for lightning arresters may safely have fairly high resistance if only the path to grounds is direct and free from inductance. For this purpose pipes driven in the ground may answer. On the other hand, grounds for secondary circuits must be of low resistance in order that the primary fuses may blow and disconnect the circuit when there is a cross between primary and secondary wires. He expressed the opinion that a buried cast-iron plate was better than a copper plate because the cast iron will be thicker and of longer life than the copper. Dr. Steinmetz strongly expressed his convictions that any electric circuit which is taken inside of houses should be grounded so as to prevent abnormally high voltages existing on the circuit, and this without regard to the normal voltage of the circuit.

## Boston Edison Stockholders Ratify Purchase of Suburban Companies.

A meeting of the stockholders of the Edison Electric Illuminating Company of Boston was held on April 29, at which it was voted to purchase the locations and property of the Chelsea Gas Light Company, the Boston Consolidated Gas Company, the Newton & Watertown Gas Light Company, the Waltham Gas Light Company and the Lexington Gas & Electric Company. This purchase covers the electric business of the companies named, and does not contemplate the retention of the gas business of any company. The prices to be paid for the electric business of the several companies are: Boston Consolidated Gas Company, $1,300,000; Chelsea Gas Company, $350,000; Newton & Watertown Gas Light Company, $500,000; Waltham Gas Light Company, $600,000; Lexington Gas & Electric Company, $120,000; total, $2,870,000. President C. L. Edgar, of the Boston Edison Company, states that it is not the intention of the directors to issue any additional stock to pay for the properties for probably a year, as the company will have about $2,000,000 cash on hand early in May, with the final payment on the last issue of new stock offered to shareholders last winter. On Monday, May 3, the Edison company began to supply power to the Boston Suburban Electric Companies' street-railway lines under a 10-year contract recently made in connection with the transfer of the electric plant of the Waltham Gas organization to the Edison interests. About 700 hp will be required at first.

## Niagara Power for Ontario Municipalities.

Definite steps looking to the distribution of electric power to the towns and cities of Ontario, between Toronto and Windsor, were taken on April 28, at a meeting of the Niagara Power Union in the city hall, Toronto, when a committee was appointed consisting of eight prominent representatives of the interested municipalities to tabulate the supplies needed by all the cities and obtain tenders on the whole from various companies. The committee was nominated by Mayor Stevely, of London. The members are: Comptroller H. C. Hocken, Toronto; Dr. Fred Guest, St. Thomas; Alderman D. A. Stewart, London; Mayor W. S. Dingman, Stratford; S. Carter, Guelph, and the officers of the union, namely, president, J. H. Fryer, Galt; secretary, J. W. Lyon, Guelph, and assistant secretary, H. L. Breithaupt, Berlin.

Thirty representatives from various municipalities in the Union were present. The feature of the morning session was an address by Hon. Adam Beck, familiarly known as the "Minister of Power," in which he quoted interesting figures regarding the work of the hydro-electric power commission. He stated its fighting days were over. The commission had been able not only to offer power to the municipalities within the first estimates, but to keep considerably under the estimated cost of the whole undertaking. He pointed out that whereas the original estimated cost of the transmission lines, transformer stations, etc., was $3,479,485, the commission had succeeded in reducing this figure by about half a million, the actual cost being $2,946,201. The commission engineers will be sent to Europe soon, said Mr. Beck, to procure information as to the best motors, lamps and other appliances, which information is to be used for the benefit of the municipalities. Among several things he predicted is a reduction of the electric light rate to 1½ cents per kw-hour and the establishment of a storage system at Dundas, Ont., probably, where power could be stored overnight to help over the difficulty of meeting the demand for power while the peak load is on.

## Iowa Discussion on Tungsten Lamp Situation.

The Iowa Electric Association at its convention at Cedar Rapids, April 21 and 22, held a discussion on the central station and the tungsten lamp situation.

Mr. Thomas Ferris, of Osage, reviewed the situation in a paper on "Effect on Central-Station Revenue of the Introduction of the Tungsten Lamp." Mr. Ferris revived the various arguments brought up by pessimistic central-station men when the tungsten lamp was first talked of. These arguments pointed to a decreased revenue because of the higher efficiency of the tungsten lamps. Mr. Ferris, however, took no stock in such arguments and thought the effect of the tungsten lamp on the central-station business had been very good. It has increased business enough to make up for any small losses in revenue from existing consumers because it brings in new business not heretofore obtainable. He thought the advent of the lamp very timely and that it had saved central-station revenue from reduction by meeting competition. In the cases of companies which charge a higher kw-hour rate on small than on large amounts, the tungsten lamp may have the effect of causing the consumer who reduces his kw-hour consumption by the use of tungsten lamps to pay a higher kw-hour rate. Then if the central station takes on additional small consumers which pay the high rate, the effect of the tungsten lamp is to raise the average price received per kw-hour.

Mr. J. P. Jones in the discussion of this paper, presented some figures on the life of series-tungsten street lamps used at Cedar Falls. This company started to use tungsten street lamps the middle of last July. The average number of hours life of the lamps which had been burned out was 572. The average life of the lamps still in service not burned out was 952 hours. There are now 225 lamps in use.

President L. D. Mathes, of Dubuque, said that the central-station man could not ignore the tungsten lamp if he would. He suggested that possibly there is more danger of loss of revenue in small towns where there is not much possibility for new business than in larger cities where new consumers could be taken on to make up for reduction and revenue from old consumers.

Mr. George S. Carson, of Iowa City, did not agree with this suggestion because in his experience the tungsten lamps raised the standard of illumination and took business away from gasoline plants which could not be possibly reached otherwise. It has also tended to broaden the peak because satisfied consumers getting a lot for their money will burn the lamps four hours a day.

Mr. F. A. Lusk, of Ida Grove, said his company's revenue had not been cut by tungsten lamps. Merchants were getting more light for the same money.

Mr. Austin Burt, of Waterloo, thought that the tungsten lamp was having the effect of broadening the peak.

Mr. C. D. Jones, of Independence, said that tungsten-lamp installations were bringing on more customers and furthermore some residence consumers which formerly used kerosene for reading now used electric lights altogether and did away with kerosene reading lamps.

Mr. George S. Carson reported that at Washington he had put in one tungsten store-light installation in place of gasoline. All of the gasoline plants in town were gone.

Mr. H. C. Blackwell, of Davenport, reported that his company formerly had 1350 gas arcs, as the company conducts both gas and electric business. Since tungsten fixtures had been introduced, 269 gas arcs and 184 electric arcs had been displaced. Three hundred and sixty-four tungsten lamps had been put in. The net result had been an increase in gross revenues for the company and the wiping out of the expense of maintenance of the displaced gas and electric arcs which formerly fell on the company.

Mr. George S. Carson, of Iowa City, said that his company furnishes fixtures for tungsten lamps free in store lighting.

Mr. Gus Lundgren, of Cherokee, reported using tungsten lamps in stopping complaints of consumers on large bills. He puts in installations on trial. A contract for a private gasoline plant had recently been headed off by a trial installation of tungsten lamps.

## The Pinch Interrupter.

At the meeting of the Armour Institute of Technology branch of the American Institute of Electrical Engineers on April 22 Mr. G. E. Marsh presented a paper on the Caldwell or Simon so-called electrolytic interrupter. In view of the fact that the "pinch" phenomenon, discovered by Mr. Carl Hering a couple of years ago and investigated by Mr. E. F. Northrup, is the principle on which the interrupter operates and that it does not depend upon electrochemical relations, it was given the name in the paper. The first part of the paper was confined to an exposition of the mathematical relations connecting the various quantities entering into the phenomenon, while the second portion dealt with the design and construction of an interrupter operating upon this principle and free from the defects usually inherent in various types of circuit-breaking devices.

The pinch phenomenon is defined as the contraction in the cross-sectional area of a liquid conductor when the current-density attains a certain value. When the current attains this value, dependent on the initial cross-section and material of the conductor, the contraction—the pinching effect—completely severs the conductor and opens the circuit. As the phenomenon is a function of the current strength and not of its direction of flow, either direct or alternating currents exhibit the effect. In the case of the supported fuse wires, enclosed types, the blowing is assisted by the contraction of the melted conductor and subsequent opening of the circuit due to the pinch effect.

This phenomenon may be ascribed to the tension of the magnetic lines of force encircling the conductor and to those existing within the boundary of the current-carrying material. By virtue of the forces directed radially inward, resulting in the reduction in cross-section of the conductor, there results a pressure directed along the axis of the conductor. If $p$ is the liquid or hydrostatic pressure, $a$ the cross-sectional area, $i$ the current per unit area of the cross-section and $K$ a constant, then $p = K a i^2$. If amperes, centimeters and gausses are the units in which the several quantities are chosen then $K$ has the value of $10^{-8}$ approximately. In concluding this portion of his paper Mr. Marsh described and exhibited a pinch high-capacity ammeter made by Leeds & Northrup, of Philadelphia; a slightly modified interrupter playing the rôle of a circulating pump was also shown.

The requirements of a perfect interrupter were mentioned, and the merits and faults of the hammer, mercury, turbine, electrolytic and pinch types of interrupters were dwelt upon. The general superiority of the last-named type, or the Caldwell of improved design, on account of simplicity, reliability and zero cost of maintenance was maintained, and in this connection an apparatus of the kind considered was shown in operation. It was of the fixed-frequency type, having three fixed rates of interruption, namely, 50, 200 and 800 per second. An induction coil of original and efficient design was shown in operation with the interrupter.

In principle the apparatus consisted of a lead box with blackened copper vanes for radiating the heat and three glass tubes having small holes in the lower ends. A lead electrode is within each tube and connected to a switch, thus enabling any one of the three tubes (frequencies) to be used at will. The tubes are immersed a couple of inches in dilute sulphuric acid, contained in the box. The frequency of interruption varies inversely as the inductance in the circuit, the size of the hole in the tube and directly with the current density.

The successful operation demands a certain amount of inductance in the circuit. As the pinch phenomenon possesses a strongly marked capacity effect, no condenser is necessary when the interrupter is used with induction coils. This last-mentioned property of the apparatus may even result in a displacement of 80 deg. or more between current and e.m.f.

## Engineers Inspect Gary Steel Plant.

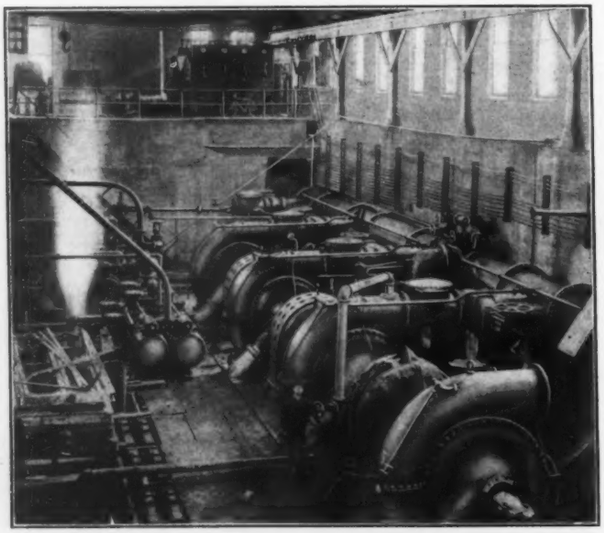
Accepting the kind invitation of the Indiana Steel Company, extended through Mr. Gleason, the general superintendent, 432 members of the Western Society of Engineers and the Chicago section of the American Institute of Electrical Engineers, visited Gary, Ind., on April 24 and inspected the new steel mills at that place which have been built in the last three years and around which has grown the city of Gary, with all modern improvements. So quickly have this city and plant sprung into being at the southern end of Lake Michigan, as the result of the combination of trained human intelligence and the expenditure of $40,000,000 in capital, that Gary is known as the "Magic City."

Mr. B. R. Shover, electrical engineer for the Indiana Steel Company, with a number of other representatives of the company's electrical staff, piloted the visitors over the extensive works, which cover about 2 sq. miles. The party was first taken to the gigantic electric ore unloaders by which the iron ore is taken from the great ore boats which bring it down from Lake Superior and dumped into stock piles or perhaps taken by conveyors directly to the blast furnaces. The gas from these blast furnaces is not allowed to waste, but after various purifying processes, is used to operate large gas engines which drive blowers or electric generators. Electric power is used throughout the entire works wherever possible, and in the power house, which is almost exactly 1000 ft. long, there are 17 2000-kw, 6600-volt, 25-cycle alternators, each direct connected to a 3000-hp gas engine.

After inspecting the apparatus to utilize the gas and the power house, the party passed to the open-hearth mill, which proved extremely interesting to all present. Here, too, electric motors are used almost exclusively in operating the charging machines and the great ladles and ingots. The rail mill, with its great 2000-hp and 6000-hp alternating-current motors, was also visited, and to many was the most fascinating part of the company's works. This mill is operated entirely by electricity, and eight operators are able to turn out 2000 tons of steel rail daily. The party returned to Chicago in the evening, after enjoying a most instructive and pleasant afternoon.

## The Water Works of the Gary (Ind.) Steel Plant.

So much interest is being manifested in different parts of the country in electric pumping for city water works that many



GARY (IND.) WATER-WORKS PLANT.

central-station companies figuring on this work will be interested in the accompanying illustration of the interior of the water-works pumping plant installed at the great steel mills of the Indiana Steel Company, at Gary, Ind. The electrical energy is supplied to this pumping station by two three-phase feeders carried on steel towers from the central generating plant of the company, which is driven by gas engines. The pumping station, as shown, contains four Platt turbine pumps, each direct-connected to an induction motor. Each pump has a capacity of 25,000,000 gal. of water per day, pumping against 100-ft. head. The pump speed is 500 r.p.m. Each feeder terminates in a bank of three 800-kv-amp transformers and each bank supplies two motors.

## Side-Rod Single-Phase Locomotive.

A type of single-phase locomotive, designed to reduce the maintenance charges on rolling stock of this class, has been tested out at Schenectady, N. Y., by the General Electric Company and the American Locomotive Company, who jointly designed and built the machine. The distinguishing feature of the locomotive is the mounting of the motors on top of the frames and connecting them to the driving wheels, not through the usual gearing nor by pressing the armatures on the driving axles, but by rods and cranks. Two 800-hp, single-phase, 15-cycle motors will form the equipment of the locomotive, which is designed to develop a tractive effort of 30,000 lb. at a speed of 18 miles per

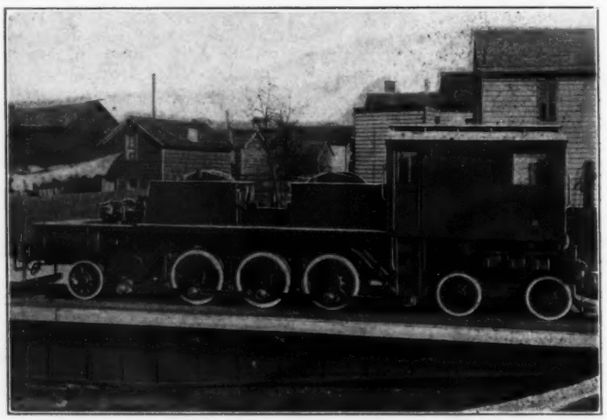


FIG. I.—SIDE-ROD LOCOMOTIVE.

hour and to have a maximum speed of 50 miles per hour. The locomotive has been equipped temporarily with two 400-hp motors for testing purposes.

The frame and running gear are not unlike those of the steam locomotive. There are three pairs of 49-in. coupled driving wheels, a radial two-wheeled pony truck at one end and a four-wheeled bogie truck at the other end. The total wheelbase of the locomotive is 36 ft. 3 in., but the rigid wheelbase is only 10 ft., which permits rounding the sharpest curves. The total weight of the machine when fully equipped will be 250,000 lb., of which 162,000 lb. will be carried by the three driving axles. This gives a weight per driving axle much higher than that on either the New York Central or the New Haven electric locomotives, although slightly less than the maximum weight employed on high-speed steam locomotives.

The motors start as repulsion motors with short-circuited armatures, and as the speed increases are changed over to series repulsion motors, thus giving the motors high starting torque and eliminating running with short-circuited armatures. The starting tractive effort is about twice the running effort on the same input. The armatures are similar to those of an ordinary direct-current motor with equalizer rings. Multiple drum-type windings with the bars soldered directly to the commutator segments are employed, and the field winding is made up in two sections, the exciting and the inducing windings. The former has the same function as the field winding of an ordinary series motor, while the latter produces the high starting torque. By mounting the motors on top of the frame, extra large bearings may be employed, and the air-gap may be reduced to a minimum,

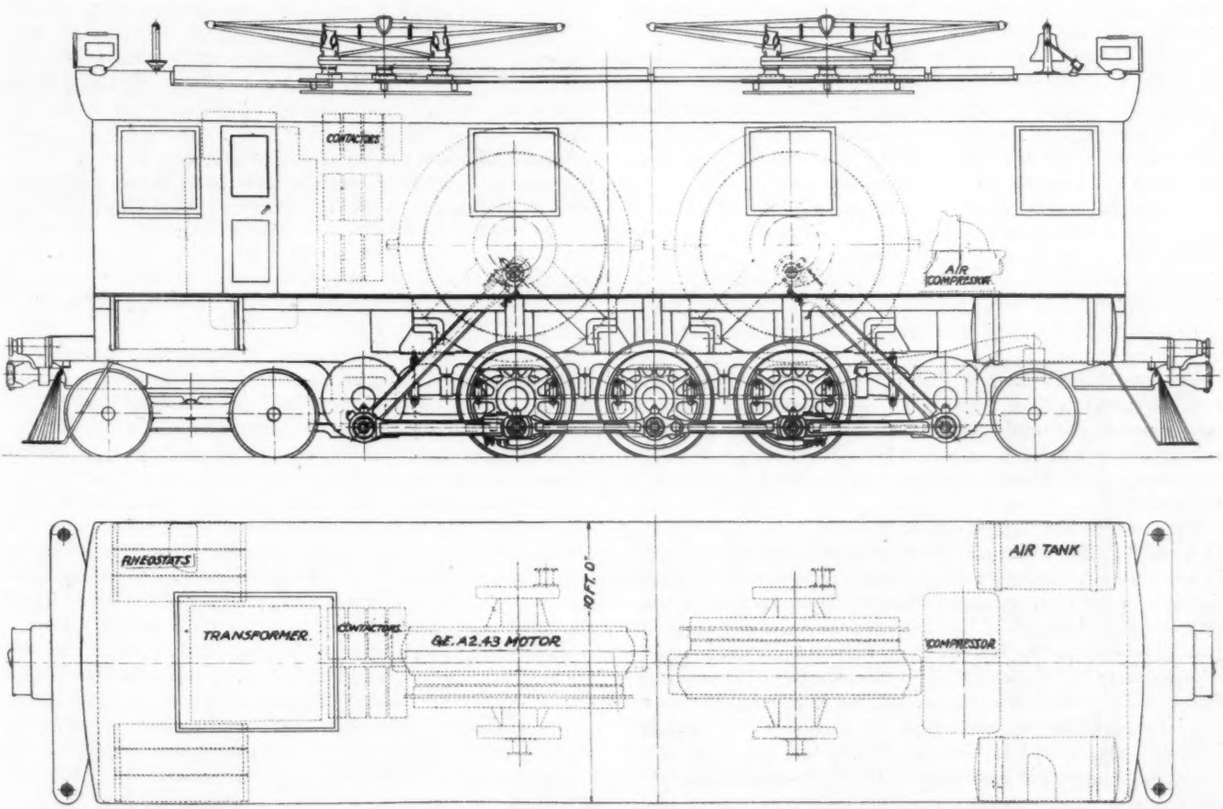
since there is no danger of the armature dropping on the pole pieces. The motors being carried on the frame of the locomotive and near the center, there are no severe shocks produced by dead weight on the axles, and the moment of inertia of the locomotive around its vertical axis is reduced to a minimum.

FIG. 2.—DETAILS OF FLEXIBLE COUPLING.

The arrangement of connecting rods between the motors and the driving wheels is illustrated in the engravings. Two jackshafts, 10 in. in diameter, and supported in bearings rigidly fixed in the locomotive frames, extend across the frames outside of the end driving wheels. Quartered crank arms are shrunk and keyed on both ends of these jackshafts and similar crank arms are attached with flexible couplings to both ends of each motor armature shaft. Inclined connecting rods extend from each motor crank arm to the corresponding jackshaft. To the same crank pins on the jackshafts are connected the driving-wheel side rods. For each revolution of the motor armatures, therefore, the driving wheels make one complete revolution and the motors revolve in exact unison, due to the mechanical connection through the driving-wheel side rods. The object of inserting the jackshaft as an intermediate connection between the motors on top of the frames and the wheels is to permit a horizontal drive between the spring-supported part of the locomotive and the driving wheels. This is necessary in order to provide for vertical play between the spring-supported part and the non-spring-supported wheels with a negligible variation in the distance between crank centers.

An interesting mechanical detail of the locomotive is the flexible coupling inserted between the motor armature shaft and the motor crank arm. The motor crank arm and its counterweight are formed in one piece, which is bored out to fit over an extension of the motor armature shaft. Just outside the armature bearing the armature shaft is enlarged in diameter, and notches are cut out to form seats for eight sets of radial leaf springs. On the inside surface of the crank-arm counterweight suitable notches are formed to seat the other end of the leaf springs. The sets of springs are fastened to the counterweight by bolted lugs which fit over the spring bands. The entire set of springs is designed to be of such strength as to carry the entire torque of the motor flexibly with an amount of deflection which will reduce the effect of the pulsating torque of a single-phase motor to a minimum.

The controller in the cab of the locomotive is mounted in the end over the bogie truck. Immediately back of the controller are mounted two transformers, and back of them the multiple-unit control switches. On the deck at the opposite end of the locomotive, over the pony truck, are mounted two air compressors for the braking system, and under the deck two large main reservoirs. This arrangement of auxiliary apparatus gives a good distribution of weight, and at the same time permits of easy access to all parts of the machine from the cab.




FIGS. 3 AND 4.—ELEVATION AND PLAN VIEWS OF SIDE-ROD LOCOMOTIVE.

## Electricity at Meeting of National Association of Cotton Manufacturers.

At the meeting last week in Boston of the National Association of Cotton Manufacturers three papers having an electrical bearing were presented. Mr. A. Thatcher Holbrook, of Boston, discussed the lighting of large textile manufacturing areas, and brought out the advantages of the Nernst lamp for this service. Mr. Day Baker, manager of the Boston office of the General Vehicle Company, set forth the economies of the electric truck for inter-factory transportation, and Mr. T. E. Chappell, of New York, had for the subject of a paper the care of commutators, in which the advantages of commutator grinders were dwelt upon. An exhibition in connection with the meeting was held in the Mechanics Building, where a number of electrical manufacturers were represented.

## Recent Developments in Chicago Telephone Service.

Reviewing the work of the Chicago Telephone Company under the franchise renewal ordinance of Nov. 6, 1907, Mr. Angus S. Hibbard, general manager of that company, gave some interesting facts in an address before the ways and means committee of the Chicago Association of Commerce on April 28. He pointed out that the requirements of this ordinance were in some particulars quite unusual and put upon the company a large amount of work. The Chicago exchange was made to embrace the entire city, which is a greater metropolitan area than that covered by any exchange in the country, and the system of rates provided by the ordinance was made co-extensive with these limits, making a telephone in the remotest corner of the city just as cheap as in the center of the loop district.

The inclusion of the small local exchanges in the outlying districts of the city, formerly connected by toll lines, has made it necessary to install thousands of miles of trunk lines in cables laid in underground conduits, connecting these districts with the city exchanges and with each other. One new exchange building, known as Lincoln, has been built and opened during the year at a cost of $180,000. Another exchange, to be known as Lawndale, is now under construction in the extreme western portion of the city. The company's toll building at 87 Franklin Street, forming an addition to its group of Main Office buildings, has been completed, and switchboards providing for the handling of messages in the territory immediately surrounding Chicago are now being installed in it at a cost of about $130,000.

The north shore underground toll cable has been completed and contains toll lines reaching all cities and towns along the lake shore to the north, and its extension by the long-distance company now reaches Racine and Milwaukee, making it one of the longest underground telephone cables now in operation in the world.

To accommodate the growth of business it is now necessary to install two and sometimes three separate telephone exchanges in one building. Believing in the future growth of the business districts in the southern part of and south of the loop, a property about 200 ft. north of Harrison Street on Federal Street has just been purchased. Upon this a fireproof building, costing with property about $500,000, is to be erected for the accommodation of the Harrison exchange and the new exchanges which will be required for the business of this portion of the city. The buildings now owned by the company in Chicago cover about 8½ acres and contain something more than 6,200,000 cu. ft. of space.

In spite of the continued depression in general business during the last two years, the applications for new service have been very numerous. When it is remembered that the telephone company cannot extend from the premises of a subscriber to a street or alley and tap a main, as is done in the case of gas, water or electric lighting companies, but must in each case provide for the subscriber's use a special circuit extending to the company's nearest exchange, limited to the subscriber alone or to a particular group of not more than four with which he may be associated, it will be seen that the plant requirements for telephone-exchange service are unusual. The lines of conduit and cables radiating from exchange offices must be pushed out in the new districts in advance of the requirements of subscribers if installations are to be made with reasonable promptness. If the engineers make a mistake and overestimate the probable needs of a particular district, unavailable and superfluous plant will be constructed; if they underestimate these requirements cables may be speedily filled and additional plant installations must be made to provide for the excess.

During the 16 months since the ordinance was passed the company has handled 59,044 "in" orders—i.e., orders upon which telephones were to be installed for city subscribers; 31,183 telephones have been ordered out; 50,541 telephones have been moved for subscribers moving from one location to another; 25,300 miscellaneous orders have been handled on account of changes in the class of service, rearrangement of service and other changes necessary to keep the lines and instruments of a subscriber in operation. This is a total of 168,068 orders for the period, or 399 for each working day. The wire plant of the company increased more than 90,000 miles during this period, reaching a total of 473,334 miles on April 1, 1909, of which 406,331 miles, or nearly 86 per cent, is contained in underground cables, leaving less than 24,000 miles of overhead wires in alley distributing lines or other locations in the entire city.

The company is now operating 31 separate exchanges in the city, of which 13 are in the so-called neighborhood exchanges located in the outlying districts. All of the company's larger exchanges are located in fireproof buildings, nearly all of which were constructed by the company for its exclusive use. The apparatus installed follows the approved standards, and there is a well-trained corps of employees, now numbering about 8100.

The injection of the flat rate into the schedule of rates at the time the ordinance was passed, against the protest of the company, was deplored by Mr. Hibbard. If one subscriber paying $125 a year insists upon using his telephone 50 or 100 times a day, he said, it must be evident that those who wish to communicate with him can do so only with great difficulty. Such a line may be found busy 10, 20 or more times before a single call can be completed to it. In the meantime the costs of operating, use of trunk lines and of operating machinery are necessarily involved in fruitless efforts. But this class of subscribers is not excessive in numbers. Out of the total of 181,533 telephones on Jan. 1 in Chicago only 9864 are of the so-called flat-rate business class.

Very nearly 90,000 telephones in Chicago were in residences, the total number being 86,546, as against 94,987 in places of business. As a comparison it may be mentioned that in New York there are about 79,000 telephones in residences out of a total of 254,000 stations. The number of exchange calls made in Chicago exceeds that of any other city.

At the subscriber's end too often calls are answered with delay because it is made the business of no one particular person to answer the telephone; some subscribers continue answering with the word "hello" or some other meaningless phrase rather than with the name of the person or firm, which latter answer avoids all delay. Subscribers' lines are burdened by useless or frivolous calls from or to employees who fail to realize that such use interferes directly and seriously with their employers' business. These difficulties are largely overcome by the introduction of private-branch exchanges with well-trained operators in charge, but it must always be true that first-class service calls for promptness and co-operation at the subscribers' end as well as in the exchange.

In its territory surrounding Chicago the company is operating about 50,000 telephones in 110 exchanges, and outside of this immediate territory connection is afforded with the long-distance lines. A recent and most careful search failed to find any city, town, village or hamlet containing as many as 200 inhabitants within 500 miles which did not have direct telephonic communication with Chicago.

"No one doubts," said Mr. Hibbard, "that the value of the

telephone in Chicago to-day, with nearly 200,000 instruments in service, is many times greater than when there were 5000 or 10,000. We do not know at what moment the service may represent its greatest value in reaching the residence of some subscriber having perhaps the cheapest form of service. This is equally true of the national system, and no subscriber can tell at what moment a message, coming a distance of 500 miles or 1000 miles, may represent a service whose value could scarcely be measured by its cost."

## Massachusetts Legislative Notes.

The Senate has concurred with the House in the suspension of the rules to permit considering a petition with the bill of Noah Rankin for legislation to authorize the town of Erving to establish an electric light district, and has referred the bill to the Committee on Public Lighting. The Senate has accepted the report of the Committee on Public Lighting referring the Coughlin bill to the next Legislature. This bill is designed to regulate the price, quality and pressure of illuminating gas in Fall River. The bill to provide for an investigation of the water-power resources of the State has been passed and will shortly be laid before Governor Draper for his approval. The Senate has accepted the Committee on Public Lighting's reference to the next Legislature of the Reno bill to authorize gas companies to adopt the sliding scale system for the regulation of prices, dividends and wages. The House has also given this report a first reading. The House has accepted the same committee's reference to the next Legislature of the Hayes bill to reduce the price of gas in the Charlestown district of the city of Boston. Under suspension of the rules a bill to permit the Beverly Gas & Electric Company to do business in Topsfield has been introduced into the Senate, and has been referred to the Committee on Public Lighting. Governor Draper has signed the bill to allow the Heath Telephone Company to sell certain stock privately.

## Design of Dynamo-electric Machinery.

Before the New York Electrical Society, at the Engineering Building on April 29, Mr. B. A. Behrend, advisory engineer of the Westinghouse Electric & Manufacturing Company, gave an extremely interesting address, illustrated by lantern slides, on the design and characteristics of modern dynamo-electric machinery. His treatment of the subject included a description of modern large generators; their principles of mechanical and electrical design; the difficulties to be overcome in securing high rotational speeds, and the various methods of overcoming them; the importance of regulation; methods of ventilation and muffling noise at high speeds, etc. The views showed various stages in building the largest and latest types of alternators, in the steam-turbine class, and illustrated very clearly the practices resorted to for cooling the parts and the manner in which the problem was dealt with of winding and securing the coils. Mr. Behrend was very frank in his treatment of the subject, and the address embodied a wealth of experience.

The discussion was opened by Mr. C. F. Scott, who traversed the general subject of dynamo evolution in a helpful way, and who was followed by Mr. C. O. Mailloux in a most striking review of the subject, going back to the beginning of the art in America. Mr. Mailloux narrated some very interesting experiences of his own in motor and dynamo design, and in doing expert work on early alternators, which were little understood and for which extravagant claims were made. His work included a motor to run a coal cutter in 1884, and a compound-wound machine, probably the first of its type. Mr. Mailloux spoke warmly of the work done by Hopkinson and the aid given by Dr. S. P. Thompson.

In spite of the wild storminess of the night, there was a good attendance and much enthusiasm. A long list of new members was elected, attesting the vitality of the society. Acting-President Beran was in the chair.

## Art in Public Lighting.

At the Conference on City Planning and Municipal Art, being held in the Twenty-second Regiment Armory, New York City, under the auspices of the Municipal Art Society, the Department of Water Supply, Gas and Electricity and the New York Edison Company show by working exhibits what has been achieved in municipal art in the domain of public lighting. By means of lamp-posts and standards placed in a row, the transition from the oil lamp of half a century ago to the tungsten standard and bishop's crook arc lamp-post of to-day is graphically shown. In addition, the New York Edison Company flanks this exhibit with numerous photographs of the various types of arc lamp-posts now used throughout the city, together with night views showing the illumination received from them. Not only are the practical aspects of civic improvement in all

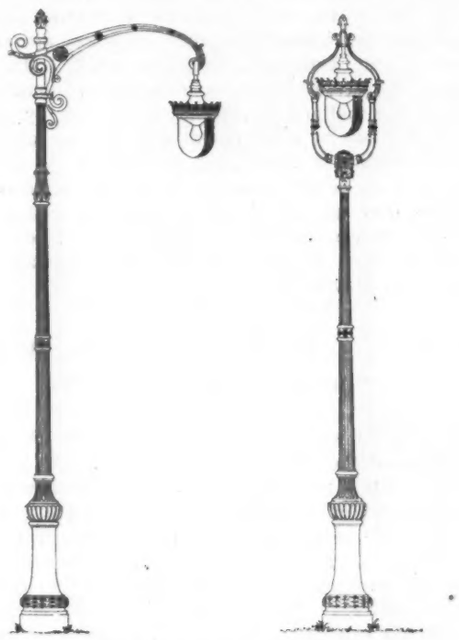


FIG. 1.—PROPOSED POSTS FOR TUNGSTEN STREET LIGHTING.

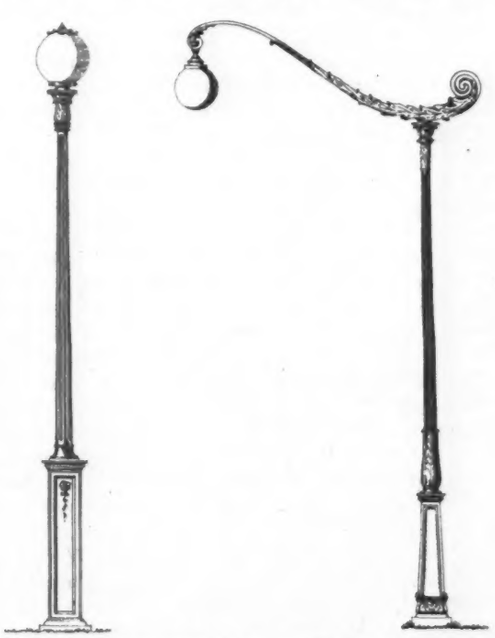


FIG. 2.—PROPOSED STANDARDS FOR TUNGSTEN PARK LIGHTING.

branches displayed by means of models, drawings, etc., but the general raising of the standard of art as applied to public street lighting in New York as well. A feature of the lighting exhibit are four proposed standards for tungsten lamps illustrated on page 1073, and numerous colored sketches showing studies in many others. The designs have been submitted to the Municipal Art Commission for approval. The remodeled naphtha lamps formerly employed for park lighting and now adapted for incandescent tungsten lamps are also in evidence. In the entire street-lighting exhibit, the only one in which the actual apparatus is employed under operating conditions, the old and the new are shown side by side so that comparisons may be made not only of the increased efficiency of public lighting in New York, but also of the esthetic taste displayed in the design of the posts, two very important accomplishments overlooked by the majority of citizens and for which the public service corporations receive scant credit. The exhibition, which is free to the public, will be open afternoon and evening until May 8.

## Hearing on Public Service Meter Specifications and Tests.

Two hearings were held on April 29 by the Public Service Commission of the First District on specifications proposed for watt-hour meters and with reference to discontinuing the use of certain types of watt-hour meters now in use which do not come up to the specifications. Representatives of all the electric lighting companies coming within the jurisdiction of the commission and also representatives of all the meter manufacturers interested were present, to discuss the report submitted on the subject by Dr. Cary T. Hutchinson, special consulting engineer of the commission. Mr. J. W. Lieb, Jr., of the New York Edison Company, who voiced the general opinion of the electric light companies, said that the latter were all in favor of a set of specifications which will cover the accepted types of meters and which will exclude improper measuring appliances or those which register in such a way as to be unfair to the consumer. The trouble, however, was that the proposed specifications seemed to be drawn up largely on the basis of the operation of the very latest and most approved types of instruments and that the application of the specifications would throw out 800,000 or more meters that are in use to-day in the United States, and giving satisfactory service.

In the matter of test, the lighting companies were agreed that a polyphase meter should be tested with both its potential circuits energized from a polyphase circuit, or under conditions which obtain in actual practice. In many of the suggested tests the watt rating of the meter has been specified rather than the ampere rating, with the result that a meter tested at rated watts with a power factor of 0.50 would carry a 100 per cent overload. Moreover, a meter on a lighting circuit would not be called upon to operate at so low a power factor, so that the limit was excessive and unusual. The specifications also call for tests with frequency variations as large as 10 per cent. It was suggested that this be changed to 5 per cent, as it is doubtful if stations could be operated under such conditions as to bring about so large a change in frequency. None of the companies objected to the discontinuance of a certain old type of alternating-current meter which registered 36 per cent slow; in fact very few of such meters are in use in New York City.

The representative of one of the lighting companies stated that his company had some 7000 meters which under the specifications would be excluded, although they are good meters, embodying all the latest improvements and register correctly. This would mean an investment of $75,000 which his company, with its tender income account, was not now prepared to make, especially in view of the fact that if the meters were tested under actual working conditions they would be found to be correct.

The manufacturing companies called attention to the fact that polyphase meters which were correct and acceptable under normal and operating conditions may be excluded under the abnormal conditions specified in the report of the expert for the commission. Variation in frequency inherently changes the power factor setting of alternating-current meters, and it is an abnormal thing to require a meter to vary 10 per cent in frequency and at the same time have a power factor of 75 per cent. A variation of 5 per cent in frequency would cover the conditions under which the meter will ever be called upon to operate. It was suggested that the accuracy of adjustment should be such that the meter would be capable of registering with an error of less than 1½ per cent and that the accuracy of registration under various conditions of load and voltage should be such that the meter would register with an error of not less than 3 per cent, the true value of the energy supplied through it at rated voltage at any current from 10 per cent of rated current, to 150 per cent of rated current.

It was pointed out that if the modifications suggested were made in the specifications all of the meters would be acceptable, except possibly the first induction meters placed on the market, which could not be expected to have the accuracy of the modern meter, seeing that it was designed prior to 1901; but even these meters were capable of adjustment and by closer maintenance would give good, average results. The tests showed that the use of this meter did not militate against the consumer but against the lighting company.

The hearing closed without indication as to final action on the specifications discussed.

## New York Public Service Commission News.

The Triborough Railroad Company was incorporated in Albany last week, backed by the same interests that make up the Bradley-Gaffney-Steers Company. It is the purpose of this new company to apply to the Board of Estimate and the Public Service Commission for a franchise to build and operate a surface electric road from Fulton Street and Flatbush Avenue in Brooklyn over the new Manhattan Bridge to the intersection of Canal and Walker Street in Manhattan. It is said that the ultimate purpose of the new company is to branch out all over Brooklyn and become a rival of the Brooklyn Rapid Transit. A representative of the new company says that if the line is built, and the Bradley interests secure the franchise for the Lexington Avenue subway, free transfers will be given between the surface and subway lines. The nominal capital of the new company is $50,000, which, of course, would be increased if the franchise is granted.

The Legislature of New York adjourned last week without having adopted the bill which proposed to amend the Public Service Commission law by giving the commission the right to fix the rate for transfers and giving it supervision over telephone and telegraph companies. What is known as the Travis-Lee constitutional amendment which excludes self-supporting dock and subway bonds from computation in the city's debt limit was finally adopted by both branches of the Legislature and will be submitted to the people for ratification at the next general election. The Legislature also adopted what is known as the New York Central Eleventh Avenue bill. This measure practically repeals the Saxe law and provides that the New York Central shall be given the right to construct an elevated and subway line on Eleventh Avenue with the approval of the Board of Estimate and the Public Service Commission. The Coney Island 5-cent fare bill, which had passed the Senate, did not reach consideration in the Assembly.

At a hearing before Commissioner Milo R. Maltbie in a continuation of the investigation of the electric companies of New York City the companies filed reports of the meter tests, both on behalf of the companies and on complaints, which have been made within the last year and a half. Mr. Delos F. Wilcox, the chief of the bureau of franchises of the commission, filed a series of maps which he had prepared from the franchise documents filed by the various electric companies showing the limits of territory in which the various companies

have the right to supply energy. After these exhibits were filed, Henry J. Hemmens, counsel for the New York Edison Company, entered a protest, stating that the maps prepared by the commission which gave the Edison Company the right to supply energy on the Island of Manhattan and that portion of the Bronx west of the Bronx River, did not accord to the company all of the rights which it really possessed. He held that his company had the right to supply energy in any part of the Bronx, or, in other words, that its right extended to the full limit of the city of New York previous to Jan. 1, 1898. While his franchises were granted previous to the time that the portion of the Bronx east of the river was made a part of the city, the company holds that the rights they obtained for the city of New York cover the entire limits of the city prior to the combination which made Greater New York. Mr. Hemmens also expressed the opinion that the franchises granted by the Board of Electrical Control were invalid. This board, he thought, never had any authority to grant franchises. The commissioner then examined J. W. Lieb, Jr., associate general manager of the New York Edison Company, upon the question of stock ownership between the various companies that have practically amalgamated. It was shown that the United Electric Light & Power Company was the only one of the subsidiary companies in which there was an appreciable amount of outstanding stock, and even in this company the amount was small. It was also shown that at least 99 per cent of the stock of the New York Edison Company was owned by the Consolidated Gas Company.

Mr. Lieb also testified at a hearing on April 30 as to the distribution system of the Edison company. He explained the system of high-tension and low-tension feeder cables, and showed upon the maps how the voltage was reduced from 6600 to that of the low-tension system actually supplying consumers. Mr. Lieb also explained the various methods of street lighting and outlined the system under which the city is now paying for its street illumination.

## Water-Power Development at Oregon, Ill.

The Oregon Power Company, of Oregon, Ill., successor to the Oregon Electric Light & Power Company, has been organized with a capital stock of $150,000 and an authorized bond issue of $200,000. Oregon is on the Rock River, between Rockford and Dixon, and the water-power available there has been utilized for a number of years. The new company will improve the water-power development, which is capable of supplying 1500 hp the year around. Electricity will be generated and sold in Oregon and in other nearby towns.

Three new Leffel turbine waterwheels, with Lombard governors, will be installed and they will drive a General Electric 600-kw, 60-cycle, three-phase, 2300-volt alternator turning at 200 r.p.m. The three turbines drive on the generator shaft and are arranged to be cut in or out by friction clutches. A second unit of three turbines and one generator of the same size will be placed in commission after the initial equipment is in operation. New switchboard equipment has been ordered, including Tirrill regulators. The water-power plant is reinforced by a steam plant of 500 hp, which will be doubled, new boilers and engines being needed.

A transmission line is being built from Oregon to Franklin Grove, 14 miles distant. The voltage of transmission is 13,200, and three Kuhlman step-up transformers of 200 kw each, placed in the generating station, will raise the generator voltage of 2300 to the line voltage. It is the intention, by the new additions and by rebuilding the old plant, to put the equipment of the new company in first-class condition throughout. Twenty-four-hour service will be given from the plant. Mr. A. M. Searles, of Chicago, who is an electrical man of long experience, is the general manager of the Oregon Power Company, and he is superintending the construction and installation of the new plant.

## CURRENT NEWS AND NOTES.

*HEADLIGHT REFERENDUM.*—The railroad companies in South Dakota will take advantage of a clause in the State Constitution to have a referendum vote on a measure which recently passed the Legislature requiring locomotives to carry electric headlights of 1500 cp.

*FIFTY ELECTRIC ELEVATORS FOR A DEPARTMENT STORE.*—In a new department store being built in New York City for Gimbel Brothers, of Philadelphia, there will be 50 electric elevators. About 7000 people will be employed in the building, which was designed by the D. H. Burnham Company, of Chicago.

*NAVAL LONG-DISTANCE WIRELESS.*—Prior to awarding the final contract for the 3000-mile naval wireless telegraph system centering in Washington, a series of tests, lasting probably three months, will be carried on at Brant Rock, Mass. Lieut. Geo. C. Sweet will represent the Navy Department at these tests.

*NEW YORK-CHICAGO WIRELESS.*—Wireless communication was established on Sunday night by the United Wireless Telegraph Company between a station on the top of the Waldorf-Astoria Hotel, New York City, and one on top of the Auditorium Annex, Chicago. The New York *Times* has arranged for a Chicago news service with the operating company.

*FLORIDA ELECTRICAL ASSOCIATION.*—At a meeting held April 21-22 by Florida electric light men, at Orlando, a State Electrical Association was formed, and the following officers elected: President, Mr. H. A. Grant, Orlando; vice-president, Mr. W. H. Bostwick, Jacksonville; secretary and treasurer, Mr. G. F. Doig, Gainesville. Directors: Messrs. F. E. Fletcher, Tampa; C. H. Ellis, Tallahassee.

*TELEPHONE RATES IN JAMESTOWN, N. Y.*—By a vote of 7 to 5 the Common Council of Jamestown, N. Y., has granted the Home Telephone Company of that city permission to increase its rates as prayed for in the petition mentioned in the issue of April 29. The permission is conditioned on the payment of $3,000 by the company to the city in settlement of litigation relating to the payment of percentages on business done. There are also some other stipulations relating to installation of telephones and the payment of percentages in the future.

*ELECTRICITY IN COAST DEFENCE.*—At the regular monthly meeting of the Boston Section of the American Institute of Electrical Engineers, held in the auditorium of the Edison Building, Boston, April 21, with Dr. A. E. Kennelly in the chair, a paper was presented by Captain Clifton C. Carter, U. S. A., on "Mechanical and Electrical Engineering Problems and Practices Relating to Coast Defence." The talk was illustrated by lantern slides. On account of the military nature of the subject it was deemed best to withhold the matter discussed from publication.

*A JOKE BY PRESIDENT ELIOT.*—In referring to his promised list of books to occupy 3 ft. of shelf room and the reading of which would impart a liberal education, President Eliot, of Harvard, said that the compilation involves a difficult problem, in the solution of which he fears to make the error of the Bostonian who bought an electrical massage machine. The machine arrived in parts, and the Bostonian could not put it together. Finally he compared the parts with the invoice, and then, in high dudgeon, wired to the manufacturer: "Machine shipped most carelessly; 110 volts missing."

*TELEPHONE REGULATION IN ILLINOIS.*—Two bills have been introduced in the Illinois Legislature providing for the regulation of telephone rates in that State. They fix maximum rates for all localities which involve some material reductions from the present schedules, and require an interchangeable service between all of the companies located in the same territory.

*NEW ENGLAND N. E. L. A. CONVENTION DELEGATION.*—Very desirable arrangements have been completed for the transportation of the New England delegation to the June convention of the National Electric Light Association at Atlantic City, including reduction in fare and special cars. Mr. Charles H. Hodkinson, 70 State Street, Boston, is master of transportation for New England.

*CONVENTION OF AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION.*—The annual convention of the American Street & Interurban Street Railway Association will be held at Denver, Colo., Oct. 18, 19, 20, 21 and 22. Exhibits will be displayed in the new Denver Auditorium and adjacent space. Mr. B. V. Swenson, 29 West Thirty-ninth Street, New York City, is secretary of the association.

*COLORADO CONVENTION.*—The Colorado Electric Light, Power & Railway Association will probably hold its next annual convention in Denver in the week of Oct. 11-16. This is the week before the convention of the American Street & Interurban Railway Association and its affiliated bodies in Denver, and no doubt many members of the State association interested in railway work will arrange to attend the national electric railway convention of the following week.

*SWINDLER USED MARCONI'S NAME.*—New York detectives have recently arrested a man by the name of Horace G. Robinson who, according to the police, has swindled confiding citizens in various parts of the country out of $1,500,000 by selling stock in bogus Marconi wireless companies. The system followed, so it is charged, was to travel over the country delivering lectures on the wonders of wireless and then taking subscriptions to the stock of mythical companies that he promised would bring in fabulous returns.

*WIRELESS AT THE LOUISVILLE SHOW.*—In an article in our issue dated April 15 on the Louisville electrical show it was stated that the wireless exhibit was not connected for demonstration at the opening of the show. We are informed by the Marconi company that this statement is in error, as both stations in the building were in working order at the opening of the show and remained in actual operation until the close, and that on the first day over 150 messages were transmitted from one station to another. The sets used were standard Marconi ship equipments.

*ELECTRICITY IN AGRICULTURE.*—Mr. William Low, of Balmakewan, Kincardineshire, Scotland, will experiment on a large scale with the application of electricity to agriculture. About 23 acres, divided in a number of fields, will be utilized for this purpose, each field including a non-electrified or controlled plot for the purpose of comparison. A network of wires will be run over the fields at a height of about 16 ft. from the ground. The poles will be put 200 ft. apart one way and 300 ft. another way. By means of transformers the voltage for the network will be raised to 100,000.

*NEW USE OF THE X-RAYS.*—In a lecture at Boston on April 26, Prof. Charles R. Cross, of the Massachusetts Institute of Technology, emphasized the widening scope of radiography. One of the latest applications considered was the use of the rays in detecting the presence of pearls in oysters, along the lines developed by Dr. Raphael Dubois, professor of physiology at the University of Lyons, France. Radiographs of 6000 oysters can be taken in one minute without injuring the shellfish and those containing no gems are put back into the sea. Others which contain small pearls are carefully kept in nurseries and allowed to develop.

*FIRE ALARMS BY TELEPHONE.*—In Chicago about 90 per cent of all the alarms of fire are sent to the fire department first by telephone and later, if there is a fire of any magnitude, by "pulling" a fire-alarm box. The Chicago Telephone Company sends monthly reports of these telephone fire calls to the chief of the fire department, and in general keeps in close touch with the department in the matter of transmitting alarms. During 1908 there were 8724 "fire calls" transmitted by telephone in Chicago, the number ranging from 522 in May to 1154 in August. During the same year there were 53,982 "police calls" by telephone, varying from 3505 in January to 5334 in September.

*CENTRAL-STATION DIRECTORY.*—The April half-yearly edition of the *McGraw Electrical Directory*, isssued by the McGraw Publishing Company, is just out, and contains no less than 666 pages of closely printed data as to the industry. Every plant reporting is shown in full details of physical equipment, rates, officers, etc., and we are glad to say that the stations now failing to report are insignificant in number and in gross output or income. The total of stations brought to account in this country is 5264; in Canada 406; in Mexico 63, and in the West Indies 7, making a grand total of 5740. Of these no fewer than 3193 report themselves as carrying electrical supplies. The gain in plants over the last issue, six months ago, is 215 net. Fifteen States—California, Georgia, Illinois, Indiana, Iowa, Kansas, Massachusetts, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Texas and Wisconsin—account for 3410 stations.

*ELECTRIC CLUB OF CHICAGO.*—At the weekly luncheon of the Electric Club of Chicago on April 28 Mr. D. W. Roper, assistant chief operating engineer of the Commonwealth Edison Company, gave a talk on "The Transmission and Distribution of Electricity for Light and Power in Large Cities." Among those taking part in the general discussion were Messrs. J. R. Deane, Guarantee Electric Company; William Carroll, city electrician; James Lyman, General Electric Company, and W. L. Abbott, Commonwealth Edison Company. Mr. Glenn Marston, of New York, spoke briefly, by invitation, on the subject of maintaining cordial relations between central stations and the public. Mr. C. A. S. Howlett, president of the club, who was in the chair, announced the appointment of a civic committee consisting of Messrs. F. J. Postel, chairman; J. R. Cravath, H. W. Young, J. G. Pomeroy, Stephen P. Gardner and W. R. Bonham.

*ELECTRIFICATION OF STEAM RAILROADS.*—At the April meeting of the Ithaca A. I. E. E. Section, Friday, April 23, Mr. Frank J. Sprague delivered an address on the subject of the electrification of steam railroads. In a comparison of direct-current and single-phase, alternating-current equipments, Mr. Sprague stated that the latter system had in some instances proved a disappointment on account of the lack of overload capacity of the single-phase type of motor. He showed that for cars of the same carrying capacity, operating at practically identical schedules, the cost of power at the generating station was the same for both systems. The weight of the single-phase equipment was, however, greater than the direct-current equipment for the same capacity, and owing to this greater weight the initial cost of motors and of car body and trucks is greater for the alternating-current system. In summing up his comparison of the two systems he declared that the direct-current system is preferable for the usual interurban or trunk-line railway for the following reasons: 1. Same or lower first cost. 2. Greater reliability. 3. Larger reserve capacity. 4. Lower total maintenance cost. 5. With increased frequency of stops a higher schedule.

# System of the Lockport Light, Heat & Power Company.

THE Lockport Light, Heat & Power Company, of Lockport, N. Y., was formed a little over a year ago for the purpose of taking over the properties of the Lockport Gas & Electric Light Company and the Eeconomy Light, Fuel & Power Company. The formation of the company and the consolidation of the two old companies were made strictly in accordance with the terms of the decision of the Public Service Commission of the Second District of the State of New York. The Lockport Gas & Electric Light Company was organized over 50 years ago and for 30 years its sole business was the manufacture and sale of illuminating gas. About 27 years ago it bought out a small company which was then engaged in selling electricity on a limited scale and since then has carried on the business of selling electricity as well as gas. The company received energy for a time from the Niagara Falls Power Company, but in 1905 entered into a contract with the Niagara, Lockport & Ontario Power Company for energy at the rate of $16 per hp-year. The large switching station of the Niagara, Lockport & Ontario Power Company is just outside the city limits and the Lockport Gas & Electric Light Company was the first customer to be supplied with energy through this switching station from the station of the Ontario Power Company on the Canadian side of Niagara Falls.

The Economy Light, Fuel & Power Company was organized in 1905 to take over the local steam-heating business of the American District Steam Company. In this business there had been invested a large amount of money for a central steam-generating plant and an expensive distribution system. In 1905 the idea was conceived that the steam produced at a properly constructed central station could be utilized in producing electrical energy for lighting and power purposes and that the exhaust steam from the engines could be utilized for heating. Accordingly the company obtained a local franchise and prepared to enter the field of electric lighting. A lively warfare ensued between the two companies and the Lockport Gas & Electric Light Company began to engage in the business of supplying steam heat. Happily the price for electricity for motor circuits in Lockport was at that time lower than in any other city in the country and the price of energy for lighting circuits was lower than in perhaps 99 per cent of the other towns and cities of the country, so that while the rate for public arc lighting was reduced because of the competition for the contract, rate cutting was not indulged in for obvious reasons. It is significant, however, that a steam-driven station using exhaust steam for heating purposes was able to compete with a company selling Niagara energy, the rate for motor circuits ranging from 2 cents per kw-hour for the first 1000 kw-hours or less to 0.64 cent for energy in excess of 80,000 kw-hours, subject to a discount of 25 per cent for payment before the fifteenth of the next month. Energy in bulk was also sold under contract method of charging on the basis of peak demand at prices ranging from $18 to $22 per horse-power per year net.

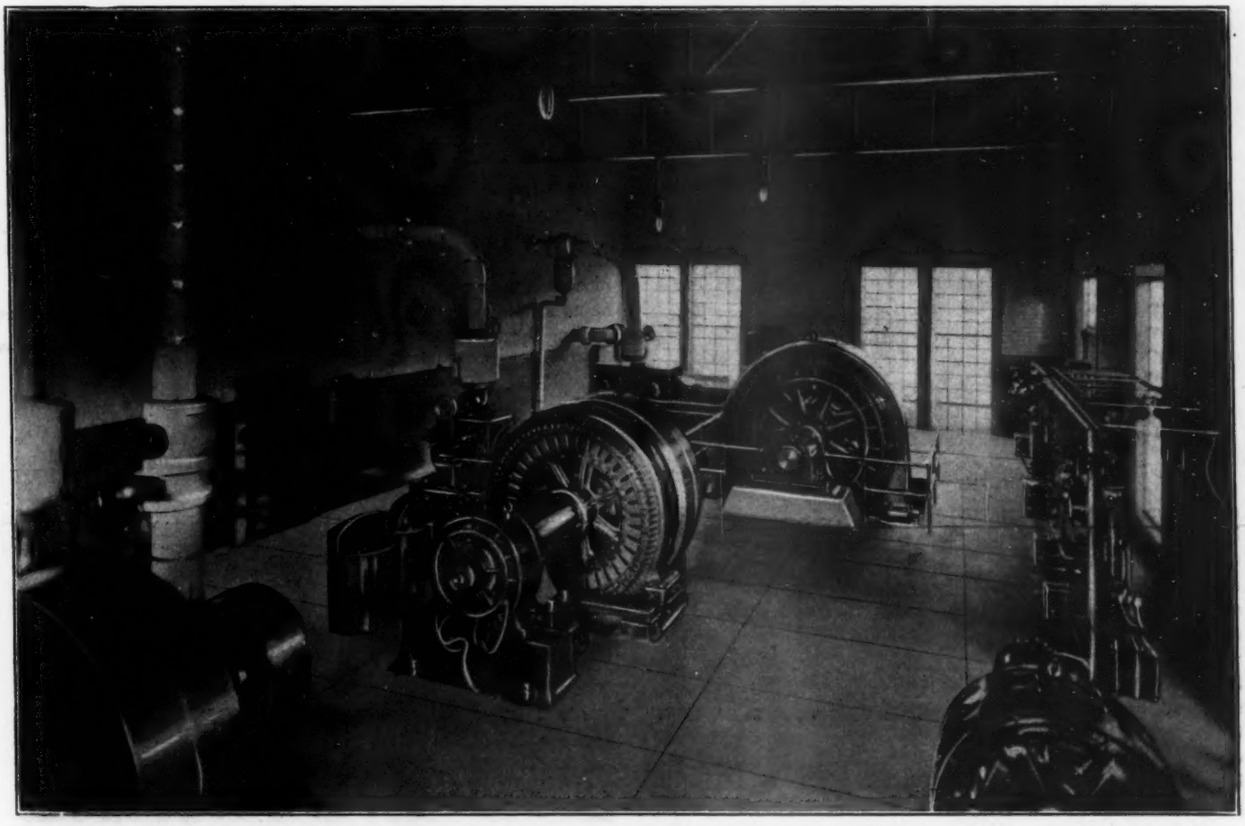


FIG. 1.—ELM STREET STATION OF THE LOCKPORT LIGHT, HEAT & POWER COMPANY.

## ELM STREET GENERATING STATION.

The plant which was erected by the Economy Light, Fuel & Power Company on Elm Street consists of approximately 1800 hp of Heine and Stirling water-tube boilers which are operated under a steam pressure of 155 lb. At present there are installed one 600-kw, 2300-volt, 25-cycle, two-phase General Electric alternator, direct-connected to a 810-hp Ball engine; one 260-kw, 2250-volt, 60-cycle, three-phase Westinghouse alternator and one 190-kw alternator of similar output and make. The latter generators are direct-connected to Fleming four-valve, high-speed engines designed to operate during the heating season under a back pressure of from 6 lb. to 10 lb. Besides the direct-connected exciter sets there is a 30-hp motor-generator set provided, and to supply a limited amount of direct current a synchronous motor-generator set, rated at 85 kw, is installed. A 10-hp induction motor is connected to the shaft of the set and is used in starting it.

The building is of steel construction, the foundations being of concrete and stone, the side walls of brick, and the front of the building of cut stone and pressed brick. A double roof is provided over the engine room, the inside roof being of book tile. The engine-room floor is of concrete and expanded

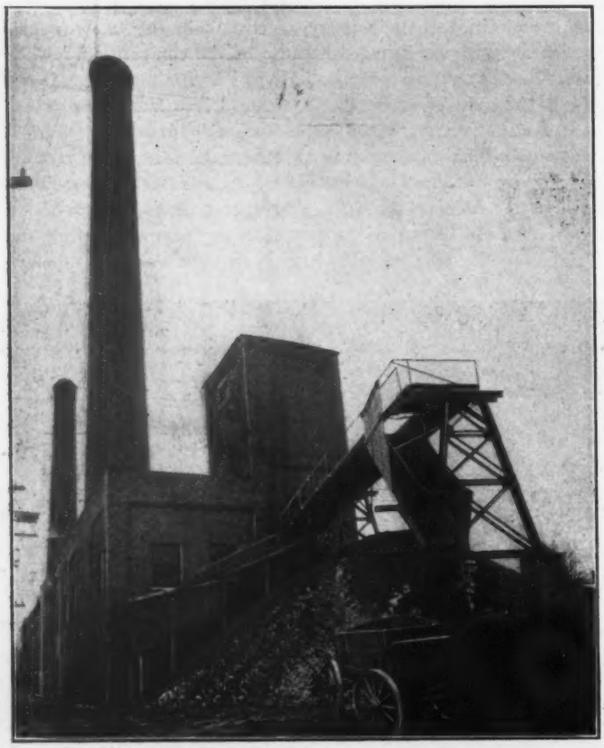


FIG. 2.—COAL-STORAGE EQUIPMENT IN REAR OF STATION.

metal upon heavy steel I-beams. The engine foundations are built entirely of concrete and are of such depth that there is no vibration in the plant. The boiler-room floor is the same as the engine-room floor, but beneath the boiler-room floor is a tunnel, 9 ft. x 12 ft., through which coal is conveyed on an endless belt operating over rollers. The tunnel is also provided with a car and track for removing ashes by means of a hydraulic elevator which carries the ash-laden car to the track overhead, whence the ashes are deposited in a bin and removed by cart. The fuel purchased is mine run or lump bituminous coal, which is first screened and the smaller coal and dust burned under the boilers while the larger coal is sent to the gas plant owned by the company. The coal is dumped directly upon the crusher, which brings it to uniform size, the crusher discharging upon an endless belt carried through the tunnel to a link belt and bucket elevator. It is there carried up into a tower 78 ft. high and provided with large storage bins. These bins discharge coal into cars which are weighed and convey the coal to a second series of storage bins located over and just in front of the various boilers, chutes from the bins conveying the fuel to motor-driven Murphy automatic stokers and smoke consumers with which the plant is equipped.

Natural draft is used, there being two round brick stacks, one 5 ft. x 127 ft. and the other 7½ ft. x 155 ft. The roof over the boiler house is of concrete and expanded metal construction on steel trusses. Beneath the roof are located Green fuel economizers, which utilize the stack gases for the purpose of purifying and heating the water. There is also located in the plant three 20,000-gal. purifying tanks for water, the Tweedale system of purification being in use. In this alum and caustic soda are employed and by means of phenolphthale in the water is tested at frequent intervals. If the water in the test tube is deep pink, alum is added, and if no pink color is shown, caustic soda is added. A faint pink color indicates that the water has been properly treated. Back of the station is a large lot which is used as storage, and on which is carried about 2500 tons of fuel. Beneath this lot also are located tunnels in which are belt conveyors, which, when required, bring the coal to the elevators.

The station operates in parallel with the other station on Race Street, but is used only during the heating season and as a reserve during the summer season should the Niagara transmission line meet with any mishap. The distribution from this station throughout the business section of the city is through underground conduits of multiple duct type in which are located lead-covered cables. Energy is distributed through this underground system at 2200 volts. Subway transformers are used throughout the business section and aerial transformers in the manufacturing and residence districts. In the same underground system are also direct-current wires and low-tension current for commercial use. The switchboard is very complete in every detail, having all the usual instruments and including also Tirrill regulators, graphic recording meters, etc.

The company has between six and seven miles of underground steam mains supplying steam for heating to approximately 12,000,000 cu. ft. of space in residences, churches, schools, public buildings and business houses, the number of customers being about 500. The first underground steam construction was installed in 1876 and has since that time been extended every year. During the past seven or eight years the old construction was taken up and the present standardized type of construction, known as the improved Holly system, was put down under the direction of the contractor, the American District Steam Company. At the time of this reconstruction the mains were also increased in size with a view of their being operated in connection with the electric light and power plant. The exhaust steam due to the operation of the engines is fully utilized during the period from the last of September until about the first of June, for heating. The steam is sold strictly by meter, what is known as the Simplex condensation meter being used. The buildings are fitted in the ordinary way, either for one or two pipe steam or for the atmospheric system, or the steam is used to heat water through the use of the American District Steam Company's design of hot-water heaters, where hot-water

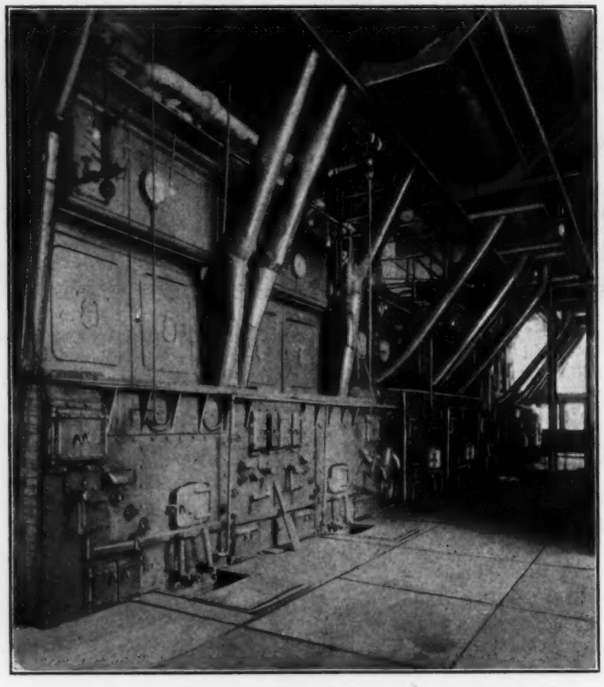


FIG. 3.—BOILER-ROOM OF ELM STREET STATION.

heating is desired in any building. Steam is also used in the heating of water for plunge or shower baths and for general domestic use in the same manner. The pressure carried in the underground mains ranges from 1 lb. to 7 lb., depending upon the outside temperature, wind velocity and humidity.

RACE STREET STATION.

The older station of the company is located on Race Street and the Erie Canal overlooking the famous locks. The site was formerly occupied by a flour mill and possesses the first right of any water not wanted in the canal. By by-passing the locks, a head of 51 ft. is available, to utilize which a 500-hp S. Morgan Smith wheel is installed. At present, while the work on the Barge Canal is under way, no water is available for power purposes. As a reserve to the water power there is a 550-hp Allis engine installed in the basement of the plant which is supplied with steam from two 300-hp Manning boilers fitted with flat grates for burning bituminous coal. A 96-ft. line shaft on the operating-room floor is belted to the engine and the shaft is also connected to the waterwheel through rope drive. The engine and waterwheel may be run together, the engine acting as the governor. Friction clutches are provided for the various belted units.

The present equipment in the station, belted to the shaft, comprises two 200-kw, 25-cycle, two-phase, 2200-volt alternators with belted exciters and four series arc machines. There are also two 200-kw, 25-cycle rotaries giving a 250-volt, direct-current service, the center of the transformers being tapped for the neutral, and a 750-kw frequency changer. The alternating-current side of the rotaries is provided with a Stillwell regulator and the rotaries are arranged to operate as synchronous motors, converters or both. They are provided with starting motors, and have friction clutches. One of the 25-cycle generators is used as a motor to drive the line shaft to which the arc machines are connected.

Energy from Niagara is received at this station through a transformer station on Transit Street, being brought underground in two lead-covered, paper-insulated, three-phase cables 2900 ft. long, made by the Standard Underground Cable Company, for 12,000-volt service. In the station on Race Street there are two 300-kw transformers stepping down the voltage from 11,000 to 2200 for local service. Last year the company purchased from the transmission company 9,561,256 kw-hours of energy. Connected to its lines are a number of manufacturing concerns using large amounts of energy.

The rates for energy for lighting range from 10 cents per kw-hour for the first 50 kw-hours to 6 cents when over 400 kw-hours are consumed, less a 25 per cent discount. The rates for energy for motors are as already given elsewhere. The bulk-rate consumers must pay in accordance with the average of the highest one-minute peaks, as shown by a graphic recording wattmeter and are required to pay a minimum of 60 per cent of their maximum minute peak. The rate for gas is $1 net per 1000 cu. ft. and the rate for steam heat is 50 cents per 1000 lb. of condensation less a discount of 15 per cent. The company advises its customers to use steam for heating, gas for cooking and electricity for lamps and motors. Mr. O. M. Diall is the general manager of the company.

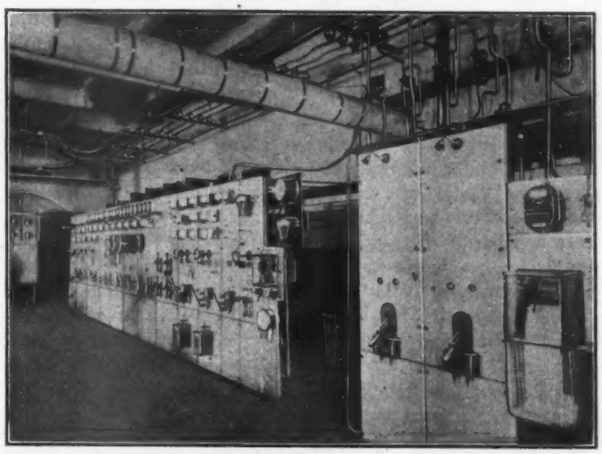


FIG. 5.—SWITCHBOARD IN RACE STREET STATION.

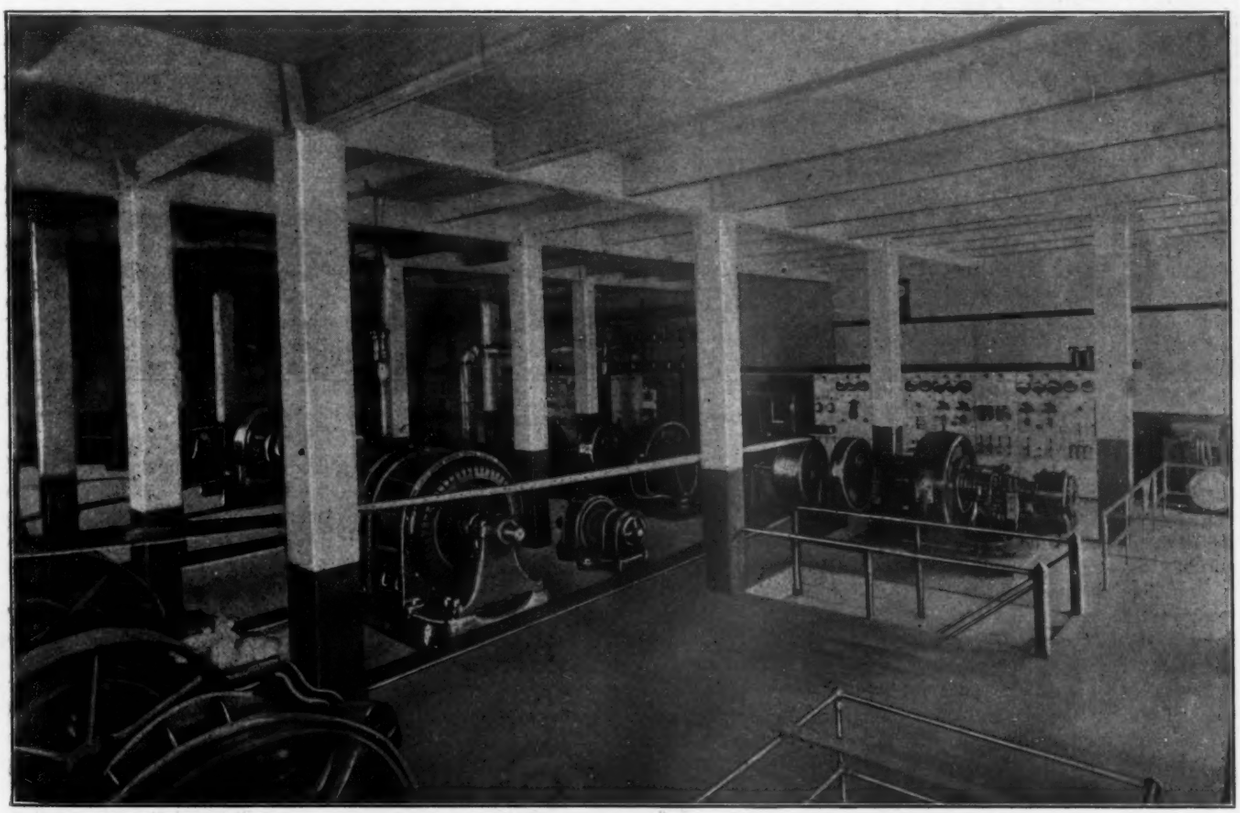


FIG. 4.—GENERAL VIEW OF THE RACE STREET STATION OF THE LOCKPORT LIGHT, HEAT & POWER COMPANY.

# The Electrical Equipment of the Gorham Manufacturing Company.

By C. E. Fairbanks.

THE electrical equipment of industrial plants varies within much greater limits as compared with each other than is ordinarily supposed on account of the considerable range in the demand, both as to quantity and type of current required in the various processes. In planning the electrical equipment—especially that for generating purposes—it is necessary to consider not only the lines of manufacture that the plant may be engaged in at present, but also any other branches that the concern may take up at some future day. This statement applied to the Gorham Manufacturing Company which, while having a world-wide reputation for its gold and silver products, has, within the last 10 years, established a reputation almost as extensive for its products in statuary bronze, architectural bronze and church ware. The extensive use of electricity in the various processes has been one of the means employed in obtaining the degree of refinement necessary in artistic work of these types.

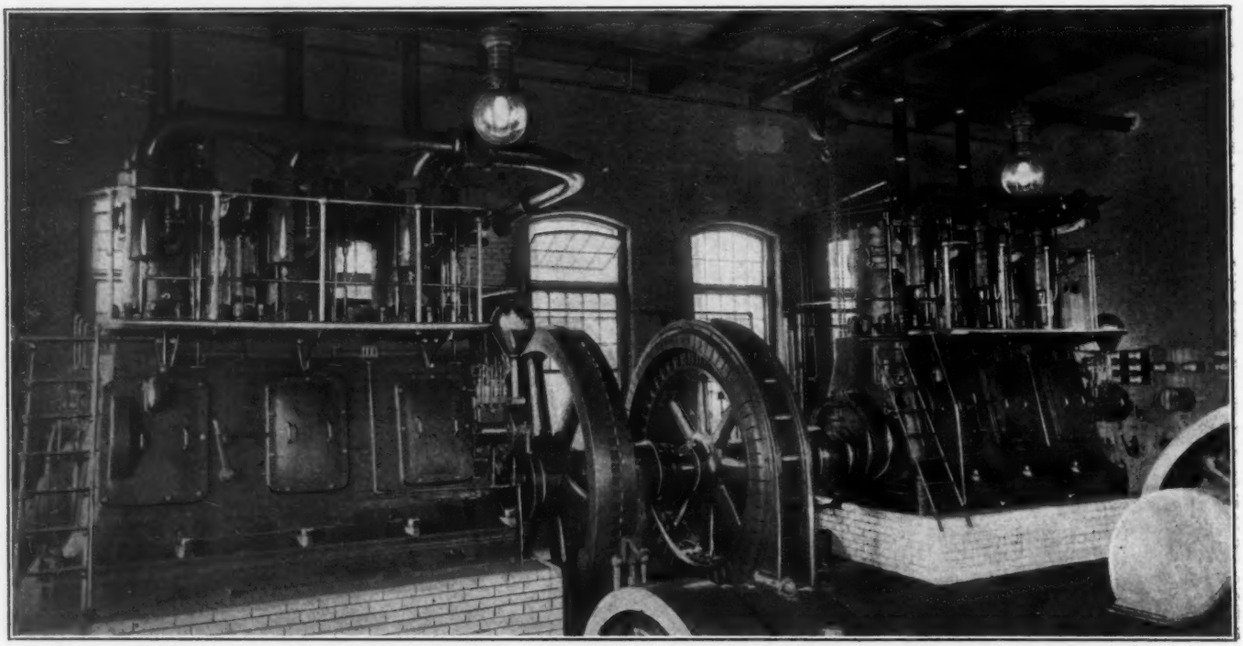


FIG. 1.—OIL ENGINES AND ALTERNATOR.

In a concern as old as this one it has naturally followed that the development of the electrical art has involved constant substituting of more economical and refined equipment for what is regarded as unsuited for the present demands. This fact explains to some extent why part of the plant equipment requires direct current, whereas the remainder uses alternating current.

In order to provide facilities for handling its products in a completed form the Gorham company has completely equipped departments for photography, printing, paper boxes, cases and cabinets, etc., each of which has its special and varied requirements in the use of electricity.

All the buildings are of standard mill construction and are three stories high; most of them have basements, making a fourth story; those buildings not having basements are provided with a tunnel for piping, conduits, etc. Originally all of the motors and lamps were operated by direct current. However, when it became necessary to put up additional buildings and extend the operations of the plant, an alternating-current system was decided upon for distribution of energy to motors. The engine-driven shafting was changed to motor-driven with the single exception of the preparatory department, in which are located the heavy stamps and rolls. Three-phase induction motors were installed, and direct-current motors were removed as the opportunity permitted. Direct current is required, however, for quite a number of purposes other than for driving motors. This current is supplied by four 125-volt generators, three of which have a rating for 800 amp and the other for 300 amp. This latter generator and two of the former are directly connected to Harrisburg compound-condensing engines, whereas the other 800-amp machine is belt-connected to a countershaft operated by a 350-hp simple Corliss engine, which is used to drive the stamps in the preparatory-room, and is directly connected by 3-ft. bevel gears to the rolls. This generator was installed for the two-fold purpose of putting an additional load upon the engine and to care for any overloads that might occur on the Harrisburg engines. As this generator is operated in parallel with the others and is located at a point away from the generating plant where the switchboard is located, an indicator is used to show at the plant when the Corliss engine is being started or shut down, and also to show at the Corliss engine when a load has been put on or taken off this generator. A "Reversite" circuit-breaker is also provided at the switchboard for this machine.

One of the most important users of direct current is the plating department in connection with gold and silver work; a total of 60 cells of storage battery are used for the tanks. The cells are grouped in weather-proofed housings on the roof. Switches are so grouped in the plating-room that any number of cells may be connected to the tanks as required to obtain the necessary voltage and amperage; a rheostat for each tank permits of further regulation. The cells are recharged at night directly from the 125-volt feeder through a regulating rheostat. The batteries for the electric automobiles, as well as the spark batteries for the gasoline cars, are also charged from these feeders. An automatic cut-out provides for any possible interruption of the supply. In the photo-etching rooms direct current is used for the Cooper Hewitt printing lamps, as well as for the electro-etching tanks. Another extensive user of this current is the department in which bottles and vases are first dipped into a metalicized solution previous to having silver deposited on them to any desired thickness; subsequently the design is outlined and the plating process is reversed, so that the surplus metal is cut away and the design remains entwined

about the glass. The printing lamps used in the photographic department are of the 28-amp direct-current type. Direct current is also required somewhat extensively in the assaying department and chemical laboratory. In all of the departments thus far named motor-generator sets are used to furnish

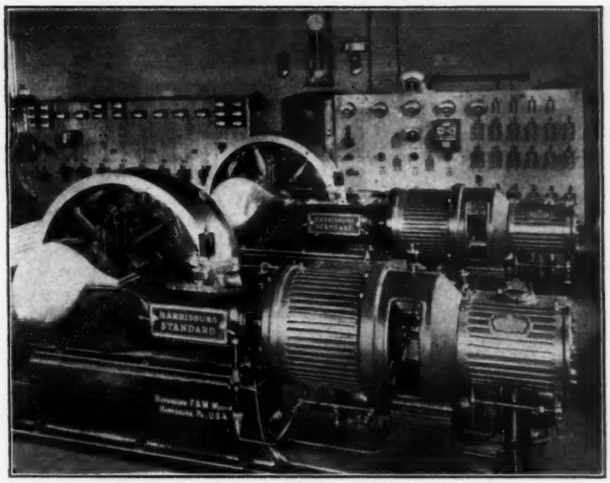



FIG. 2.—VIEW OF ONE END OF POWER PLANT, SHOWING SWITCHBOARDS AND ENGINES.

the current. These sets are driven at present by direct-current motors, as they were installed before the installation of the alternators. Numerous small direct-current motors, such as exhaust fans, desk fans, etc., as well as some of the larger direct-current motors up to 30 hp are in service for the reason that their operation is continuous for 16 hours per day and until the present plans are carried out alternating current is not available after 6 p. m.

The general lighting system for the buildings consists of 4900 incandescent lamps and about 100 arc lamps or tungsten clusters. These are operated from the direct-current system as these generators are in service 24 hours per day. The attached curve shows the demand throughout the average day. The night lamps are required by the watchmen and some of the motors that operate at night. The arc lamps are being replaced with clusters of tungsten lamps using from four to six 60-watt lamps per cluster. Not only does this arrangement give a more uniform candlepower, but the color value of the light is vastly superior around machinery, especially where oil is in evidence.

Tungsten lamps are used in circular arrangement to illuminate the dials of the tower clock; also in departments requiring a high grade of light, such as the engraving, shipping, accounting and display departments. The grounds are illuminated with arc lamps, but incandescent clusters are located at the corners of the buildings and on the bridge. The statuary-bronze building, which is 90 ft. x 200 ft., is lit by four flaming-arc lamps which replaced 12 enclosed arcs. Yellow rays have been found to penetrate the smoke and dust of the foundry much better than any other. Direct current is required in this building to operate the four motors on the 25-ton traveling crane.

At the present time there remains a total of only 200 hp in direct-current motors; this number will be much reduced as soon as additional contemplated alternating-current generators are installed.

The motors for the factory consist of 800 hp in induction motors of various ratings up to 40 hp. In the case of individual machines, such as pumps, planers, etc., the motors are directly connected, but in the case of shafting the greater proportion are chain-driven. The service is 550 volts, three-phase, 60 cycles, the energy being furnished by a General Electric alternator which is directly connected to a 500-hp Diesel oil engine.

The air compressors for this engine are motor-driven and are located in the pump building with other compressors. A 100-kw turbine outfit will shortly be placed to operate in parallel with this engine and to be used at night and other times when energy is required for overtime work—of which there is naturally considerable. At present the overtime is taken care of by energy furnished by the Narragansett Electric Company at a pressure of 2200 volts through three 75-kw transformers.

The switchboard has an indicating wattmeter and an overload-releasing oil switch for each set of feeders. A separate panel is provided for the Narragansett Company's service; besides the regular hand-operated oil switch there is a solenoid-actuated oil switch located in the transformer-room with a controlling switch on the panel above referred to. The circuit for this switch continues on to the alternator panel, so that the two systems may be thrown in parallel. A synchroscope is used for indicating synchronism. The switchboard is equipped with the usual watt-hour meter, power-factor meter, ammeter for each phase, etc. The alternator is excited by energy from the direct-current switchboard. For machinery requiring a variable speed use is made of variable-speed induction motors. The polishing-room has in service approximately 280 polishing heads, which are driven in groups of from 20 to 30 by 10-hp motors. A 40-hp motor directly connected to a double Sturtevant fan is used for the twofold purpose of drawing fresh

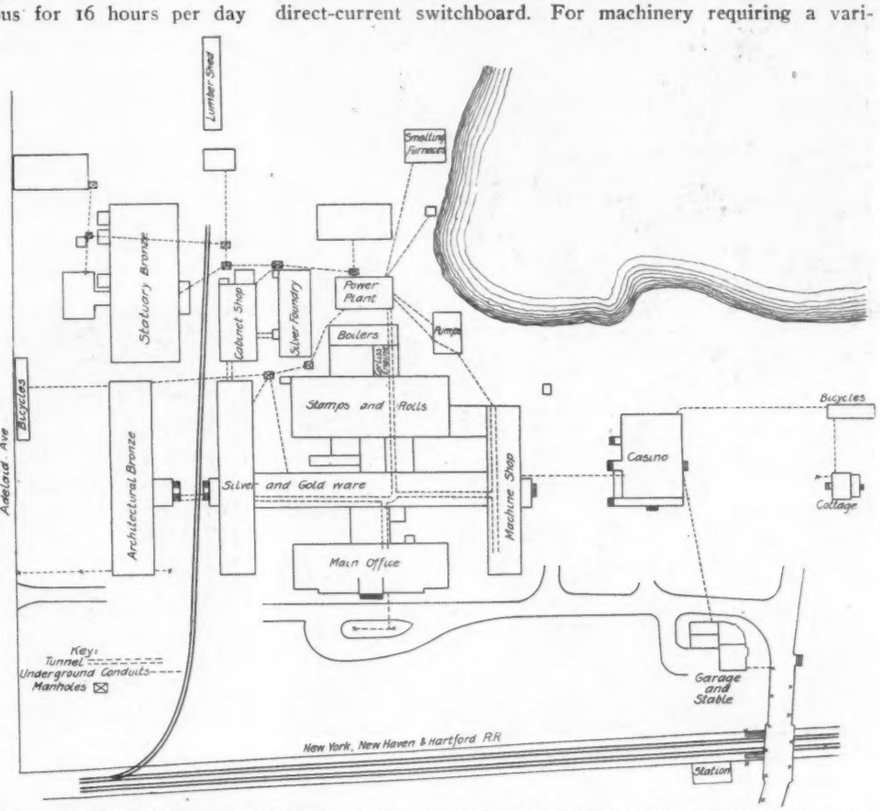



FIG. 3.—ARRANGEMENT OF BUILDINGS, GORHAM MANUFACTURING COMPANY, PROVIDENCE, R. I.

air into the room and carrying the dust from the polishing heads; this dust is strained and the silver is reclaimed. Induction motors are also used to drive the pressure blowers employed for feeding oil into the silver and bronze melting furnaces. Besides this, air at 80 lb. is furinished for pneumatic

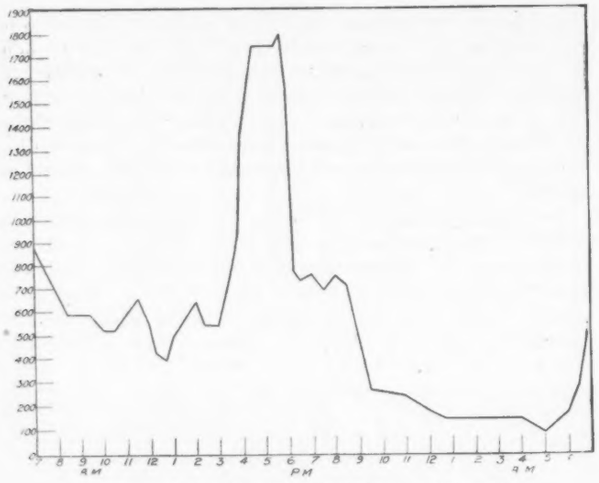


FIG. 4.—LOAD ON DIRECT-CURRENT GENERATOR.

tools. Quite a number of portable electric drills, grinders and other types of small tools are in service. In the pattern and carpentry shops all sawdust and shavings are gathered by a motor-driven exhaust fan and delivered to the boiler-room. Steam for the engines, jet blowers, scrubbing tanks, etc., is

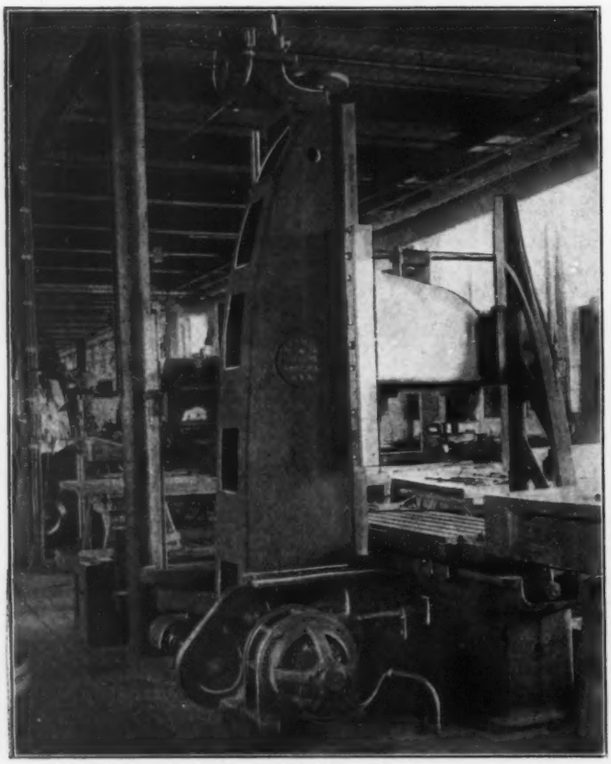


FIG. 5.—DIRECT-CONNECTED OPEN-SIDE PLANER.

furnished by a battery of six vertical Corliss boilers, which will shortly be replaced by Stirling boilers in a new boiler-house.

A card record is kept of all motors and generators of any size or type. The face side of the card gives all data regarding the machine, its location and what it is used for. The reverse side has a space for tabulating any former history of the machine and all repairs made from time to time. The shop number assigned to a machine not only identifies the machine in the inventories, but also gives the location. For example, 2-C-19, means that the motor is on the second floor of building "C" and is No. 19. A map shows the location of No. 19 in the building and also in what department it is.

Not the least important of the electrical equipment is that for the time system, which is operated by a battery of 50 cells of storage battery. The time system includes 40 secondary clocks operated by a master clock, which is, in turn, synchronized with a tower clock. This master clock also operates the relays controlling the work gongs and time-check boxes. The former consists of 33 8-in. and 14-in. electro-mechanical single-stroke gongs located one in each department; these strike at the hours of 7, 12, 1 and 6. The same gongs are used in conjunction with the fire-alarm system; 30 stations are connected by cable to an annunciator, and when fire is recorded the alarm is sounded throughout the factory by striking the signal indicating the station; a trained fire-fighting force having reels, extinguishers and hose stations constitute a part of the working force. A double 18-in. x 10-in. x 12-in. Worthington pump is always ready for instant service. The check boxes are located at the entrances to the buildings and are connected with the various floors by tubes; an electro-mechanical movement operates these boxes each 15 minutes so that a new compartment is presented for the reception of checks. The master relay which controls these circuits is so connected to the one for the gongs that they operate in synchronism at the proper hours. This arrangement records the working time of between 2000 and 3000 persons.

The Casino building, in which are located dining- and lunch-rooms for men and women, has also spacious reading-rooms, shower baths, etc. This building is electrically equipped throughout with every convenience for the laundry, lighting, etc. At present the cooking is done on coal ranges.

The telephone service is furnished by 85 instruments connected to a Kellogg 100-line common-battery board, the energy for which is furnished by two banks of 11 "Chloride" cells.

Excepting the 2200-volt service mains which enter the grounds at the rear of the power plant all feeders, cables and wires are underground. To reach the buildings tile ducts are laid so as to radiate from the power plant, with manholes at proper points for the easy pulling of the cables and for the further purpose of diverting the ducts in other directions. The manhole heads are raised above the ground level about 4 in. so that in heavy rains no water will run inside; all ends of ducts

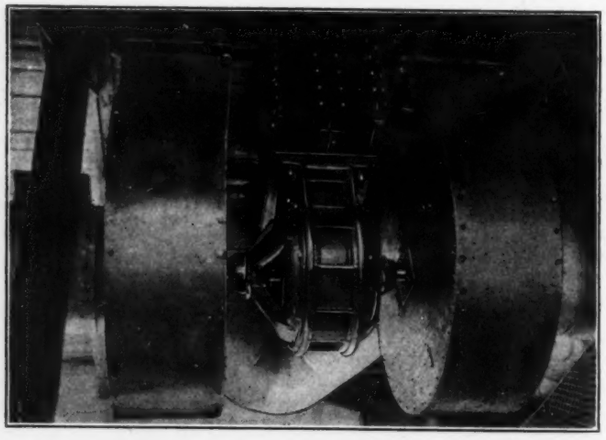


FIG. 6.—MOTOR-DRIVEN EXHAUST FAN FOR THE POLISHING ROOM.

are sealed as a further preventive. The buildings have either a basement or a pipe tunnel and all cables and wires are carried in 3-in. piping laid on brackets in these tunnels. The motor and lamp wires are run open on the ceilings, but all wires on side walls and where they can be reached are in conduit. The time-system circuits are carried from the power plant, where are located the master clock and relays, through a 40-wire rubber-

insulated cable to a point at the center of the buildings; it is there terminated in a slate terminal box, and smaller cables of a similar nature ramify to sub-centers of distribution. The individual instruments are reached with No. 14 duplex wire. The telephone circuits are in lead-covered, paper-insulated cables. The major portion of the electric lamp wiring is on open porcelain cleats, although a considerable portion is placed in conduit. Weather-proof and moisture-proof switches and sockets are used in damp places, the gas house and places of a similar nature. All of the wiring is of rubber insulation with single-braid or double-braid covering, as conditions demand.

The mechanical equipment of this factory has many interesting features. It has been made to harmonize with the electrical equipment, so that there is a close relation between the two, and the motors carry three-fourths to full load all of the time, thus keeping the loading factor for the entire plant up to 80 per cent.

## Electricity in Buffalo, N. Y.

By George J. Kirchgasser.

SINCE the introduction of energy from the hydro-electric plants at Niagara Falls, the employment of electricity for lamps and motors has increased wonderfully. Its increased use for motors has been most striking in recent years, the Cataract Power & Conduit Company now claiming to supply energy for almost 75 per cent of the manufacturing industries in Buffalo. According to recent rating, this company stands fifth in regard to kw-hour output; the Niagara Falls Power Company being first. Old industries in Buffalo are steadily changing from steam to electricity; new ones are equipped to use Niagara Falls energy, and a large number of individual motors for industrial purposes have been installed within the last four or five years, thus filling out the load curve during the regular working hours of the day. In 1903 and 1904 the curve indicated a low day load with the peak between 4:30 and 5:30 p. m. The use of small motors for various purposes and the introduction of household electric appliances have also helped to create a better load factor.

Electricity was first brought to Buffalo from Niagara Falls (Niagara Falls Power Company) about 12 years ago, the tension on the transmission lines then being 11,000 volts. In a short time the output of the plants was increased, the transmission voltage raised to 22,000, and by the latter part of 1904 nearly 25,000 hp was delivered at the Buffalo terminal station. Since then there has been a still greater percentage increase, energy now being delivered from plants on both American and Canadian sides of the Falls. In the American plant electricity is generated at a tension of 2200 volts and is stepped up to 22,000 volts, at which pressure it is delivered at the Buffalo terminal station "A," at Niagara and Ontario Streets. The alternators in the Canadian plant (Canadian Niagara Power Company) are wound for 11,000 volts, about 50,000 hp being available when the last bank of transformers is installed at the new terminal station "B," which is situated on the Niagara River at the junction of Front Avenue and Niagara Street. This station is only about 1½ miles from the business center of the city and about three miles nearer than terminal station "A." By running the transmission lines on the Canadian side, which is all open country and thinly populated, to directly opposite station "B," a voltage of 22,000, with its economical transmission and overhead construction, could be run to within a short distance from the heart of the city. Substations are fed by underground cables run in ducts at a voltage of 11,000, and the arrangement is such that energy can be delivered from both terminal stations or from either. The underground cable lines from station "A" are of a greater length and, therefore, more costly than those from terminal station "B," which has the more central location. The two power plants that supply Buffalo have an output of 155,000 hp at present.

As the first transmission lines were brought from the American Falls, the first terminal station had to be placed at the outskirts of the city because of the high voltage of the overhead system. When this station was equipped in 1900 there were seven 2250-kw transformers used to reduce the transmission voltage, which had been raised to 22,000 at the Falls, to 11,000 for distribution to the substations of the city. These transformers are of the oil-immersed, water-cooled type, and when installed were the largest in use. It was deemed preferable to use 11,000 as the voltage for underground cables and suffer the extra copper loss besides the 2 per cent in the transformers rather than use 22,000 volts for the underground transmission. This station's equipment proved sufficient up to 1905, when the increased load became an overload. Since the new terminal station was put in operation the load has been divided and is well taken care of.

The arrangement of this terminal station is very compact and simple. On one side are the incoming high-tension switchboards and on the other are the 11,000-volt distributing switchboards supplying the substations. There are three banks of transformers of 9000 kw each and a fourth bank nearly finished, making a total rating of about 50,000 hp. There are four three-phase, 22,000-volt, 25-cycle transmission lines entering on the high-tension side. The span across the Niagara River from Canada is one of the longest of its kind in the world, the distance being between 2100 ft. and 2200 ft. On each side of the river is a large steel tower, about 200 ft. high, which supports the wires. The great length of span causes a very great strain and some trouble has been experienced by the snapping of cables, due to extra weight of clinging sleet during the winter. The first three lines were of aluminum wire, and although each wire is counterweighted, sagging has occurred which at times allowed the wires to swing closer to each other and occasionally caused a display of fireworks out over the river. Three or four cables have snapped and were lost in the river. A bimetallic wire has been used on the fourth line, which has just been completed. This wire has an inner core of steel and an outer surface of copper, and, besides having a greater tensile strength, it is said to have other advantages over the aluminum wire.

The Cataract Power & Conduit Company and the Buffalo General Electric Company employ four systems of alternating-current distribution, run overhead from substations at 2200 volts, which are divided as follows:

1. Single-phase, 60-cycle, operating at approximately 104 volts and 208 volts; 104 volts being used almost exclusively for lamps, the hp-rating of motors fed from this system being some fraction of 1.

2. Single-phase, 25-cycle, operating at approximately 110 volts and 220 volts for lamps and motors as on the 60-cycle system. As the motors used on these systems are small, no disturbance is caused to the voltage on starting. The largest motors are a 5-hp and a 15-hp, both of the Wagner type.

3. Three-phase, 25-cycle, operating at 220 volts and 440 volts for motors, rated at 2 hp or 3 hp.

4. Three-phase, 25-cycle, operating at 2200 volts. This is supplied and reduced in private transformer stations to voltages of 440, 220 or 110 for motors and lamps in factories, etc. There are also a number of large 2200-volt induction motors installed about the city, several being added recently. A better rate is the result of having current delivered on the premises of the consumer at 2200 volts.

The direct-current distribution systems are as follows:

1. The three-wire system, operating at approximately 110 volts and 220 volts for lamps and motors. For 110 volts the motors used are very small—¼ hp or less. This system is underground and supplies the down-town district, as it is well adapted for the congested sections and is economical in the amount of copper used.

2. Street arc lighting. This is at 6250 volts, constant current, being separated from all other systems and never used for inside service.

3. Five hundred-volt, for motors only. This is used for the large number of direct-current motors, the rating of which is

usually between 5 hp and 10 hp, though some are much larger and others are as small as 1 hp. As the induction motor in recent years has reached such a high standard, the number of direct-current motors installed on this system has decreased and alternating-current motors, both single and three-phase, are now being installed to a very great extent.

The Cataract Power & Conduit Company distributes the energy from the terminal stations to substations and supplies energy to large motor users and also for lamps in the remote sections of the city; the frequency of all the systems being 25-cycle. The primary function of this company is that of wholesale distributor of power.

The Buffalo General Electric Company gets its energy from Niagara Falls through the Cataract Power & Conduit Company's terminal stations and distributes it through the street arc system, the Edison three-wire system, the 500-volt direct-current system, and nearly all the alternating-current systems for lamps and motors in the city, both 25- and 60-cycle being used. Most of the residential sections are fed from 25-cycle circuits, and almost 25 per cent of the total load of incandescent lamps on the alternating-current circuits are operated at this frequency. In 1905 the rating of transformers operating on 25-cycle lighting circuits was about 20,000 lamps. As this number has increased since then this frequency must be thought satisfactory, except where a number of lamps, say, from 9 or 10 up, are placed short distances from each other. In this case very slight flickering is noticeable with ordinary carbon-filament lamps and marked flickering with tungstens. Where a large number can be seen at one time, the slight flicker of one, happening at the same time as each of the others, is discernible to the eye.

The Cataract Power & Conduit Company has four substations from which 25-cycle current is distributed at 2200 volts.

The Wilkeson Street substation adjoins the Buffalo General Electric Company's main substation and consists of an equipment of 30 250-kw air-blast transformers, making the total rating about 11,000 hp.

The equipment of the Babcock Street substation consists of 18 250-kw transformers, reducing from 11,000 volts to 2200 volts, and three 275-kw transformers reducing from 11,000 volts to 375 volts. These are also of the air-blast type and are in the same building with the Buffalo General Electric substation apparatus.

In the Ohio Street substation the rating of the transformers is about the same as at the Babcock station. This station supplies the southern part of the city.

At East Ferry Street the substation has been in operation only about two years. Alternating current is supplied for the east and northeast section of the city. The arrangement of apparatus is very simple, the high-tension switchboard being on one side and the low-tension distributing panels on the other; of four three-phase, 25-cycle circuits leaving the building overhead, one circuit belongs to the Buffalo General Electric Company. There are nine 300-kw transformers set in rows of three each, and a fourth row is soon to be added. These transformers are of the Westinghouse oil-immersed, water-cooled type, the temperature usually being about 40 deg. C. The outgoing lines are provided with choke coils and multi-gap lightning arresters.

The Buffalo General Electric Company has four substations, the main one being on Wilkeson Street, near the heart of the city, and supplied the entire Edison three-wire system up to a few years ago. Its equipment in detail is as follows: Six synchronous motor-generator sets are used to change the frequency from 25-cycle to 60-cycle for the lighting circuits. The alternators of these sets are rated at 200 kw and generate electricity at 2200 volts, 60-cycle, three-phase, while the synchronous motors are rated at 365 hp, and operate on 350-volt, three-phase, 25-cycle circuits. For the three-wire system there are five dynamos generating at 125 volts, with the following ratings: Two 250-kw machines direct-connected to one three-phase, 350-volt, 370-hp synchronous motor; two 333-kw machines direct-connected to a 1200-hp, three-phase induction motor. The fifth dynamo is of 100-kw capacity driven by an induction motor. Some of this direct current is also used for exciting the fields of the alternators and synchronous motors in the station. A storage battery is used to take up the fluctuations of the load on the Edison system and also to carry the peak.

All (almost 3000 hp) of the 500-volt direct current is generated at this station, except, of course, that used by the International Railway Company. There are three 600-kw and two 200-kw, 500-volt rotary converters used on this system. About 75 per cent of the street arc-lamp circuits are fed from this point. There are 26 Brush arc dynamos (6250 volts, 9.6 amp) located here, 200-hp, 350-volt synchronous motors being direct-connected, some to two and some to three generators.

The Main and Court Street station is built under the sidewalks of one of the busiest corners in Buffalo, and probably not more than one in 10,000 of the many people who pass over this station know of its existence. This subterranean station was fitted up to help out the Wilkeson Street station as the load on the three-wire system had increased to such an extent as to make necessary an increase in underground feeders from the latter station, which is three-quarters of a mile from some points of the business section. The equipment consists of three 186-kw, air-blast transformers reducing from 11,000 volts, together with the necessary oil switch and potential regulator. In addition there is a 500-kw rotary converter, which feeds into the three-wire system at 250 volts.

About two years ago a further increased load on the Edison system made it necessary to install another substation at Swan and Ellicott Streets to take care of the business section farthest away from the Wilkeson Street station. The equipment is also placed underground, and is similar to that in the Court Street substation except that there are two rotaries instead of one.

The Buffalo General Electric Company and the Cataract Power & Conduit Company have their substation equipment under one roof at the Babcock Street station. The Buffalo General Electric Company has one 250-kw transformer; four pairs of Brush street arc-lighting machines, each pair driven by a 200-hp, 350-volt synchronous motor; three motor-generator sets, the generators being rated at 200 kw, each operating at 2200 volts, 60 cycle, and the motors being 570-hp synchronous machines, operating on the 11,000-volt, 25-cycle system. For exciting the fields of the alternators and synchronous motors there are three motor-generator sets, the motors, two 30-hp and one 15-hp, being of the induction type and operating at 350 volts, 25-cycle; the generators are wound for 125 volts direct current. The 60-cycle alternating current from this station brings up the total for the city at this frequency to 1800 kw.

By employing synchronous motors at two substations, the Buffalo General Electric Company is able to keep the power factor of the system near unity. The synchronous motor is also practicable at 11,000 volts, while the induction motor is not, and constant speed is also assured regardless of drop in line voltage.

Four years ago the International Railway Company, of Buffalo, received from Niagara Falls about 7000 electrical hp. At the present time this company has a total equipment at its several substations capable of supplying between 20,000 hp and 25,000 hp of direct current at 500-550 volts. There are four substations, the main one being on Niagara Street within 100 ft. of the Cataract Power & Conduit Company's terminal station "B." Here there are two 1000-kw and one 400-kw rotary converters, three 750-kw, engine-driven, 500-550-volt, direct-current generators, and two 1500-kw, engine-driven alternators wound for 11,000 volts. These latter machines are used at peak load and in case of interruption of Niagara Falls circuits. The transformers are of the air-blast type and current at 11,000 volts is received from either terminal station "A" or "B" (that is from either the American or Canadian plant) or from both. This has bettered former conditions, when station "A" supplied all the electricity to the city. As a street railway load is liable to sudden fluctuation, the rotary converters are started on the alternating-current side. A large storage battery is also installed at this station.

The Virginia and Washington Street substation contains seven 1000-kw rotary converters and a large storage battery; at Seneca and Imson Streets there are three 400-kw and one

1000-kw rotary converters, and the Waldon Avenue station has five 400-kw rotary converters. These substations are located in different sections of the city so that each has a number of lines to take care of. Electricity at all substations is received through underground cables at 11,000 volts. Most all of the apparatus used in the substation of the Buffalo General Electric Company, the Cataract Power & Conduit Company and the International Railway Company is of General Electric manufacture, a small share being of Westinghouse make.

Another interesting illustration of the increased use of electricity may be seen in the three 1500-hp direct-connected motors and two-stage centrifugal pumps that have been installed at the pumping station of the Buffalo water works during the past four years. The first of these was put in use in 1905; the third has just been installed. There are three large air-blast transformers, one for each motor, and two small oil-cooled transformers for lighting and small motor circuits, reducing from 11,000 to 2200 volts and from 11,000 to 220 volts, respectively. The pumps are vertical, with the motors at the upper end of the shaft, and each is rated at 25,000,000 gal. per 24 hours. The efficiency of the transformers is claimed to be 98 per cent, of the motors 91 per cent, and of the pumps 80 per cent, making the combined efficiency 71.4 per cent. Pump No. 2 operated at an average of 22,200,000 gal. of water per 24 hours, for the latter part of November and the first half of December, 1908, or 128,580 lb. of water lifted per minute; as the head against which the pump works is about 192 ft., 750 hp represents the work done to the water. At the combined efficiency of 71.4 per cent, the electrical horse-power supplied by the Cataract Power & Conduit Company to the pumping station for pump No. 2 equals $750 \div 0.714 = 1050$, which is the average supplied for the month Nov. 15 to Dec. 15, 1908. These electrically driven pumps are more economical and take up so little room compared with the large, inefficient triple-expansion steam pumps which form part of the station equipment, and carry their load so readily, that it is not surprising that since the first installation in 1905 two more have been added.

A comparison might be made with a similar pump at the Duluth water works. Here a General Electric 1000-hp induction motor direct-connected to a two-stage vertical centrifugal pump has lately been installed, the capacity being 13,000,000 gal. per 24 hours against a head of 300 ft. If the combined efficiency is 73 per cent, as claimed, the horse-power which must be supplied is 937. At Buffalo 1228 hp is supplied for each pump when operating at the full capacity of 25,000,000 gal. For each 1,000,000 gal. pumped at the Duluth works $6.50 is paid, while in Buffalo the rate varies with the amount pumped per month. As the number of gallons pumped per day varies between 22,000,000 gal. and 24,500,000 gal., the total for each unit is between 650,000,000 gal. in the short months to 700,000,000 gal. for the others, so that a discount of 44.44 per cent is made on the rate of $9 per 1,000,000 gal. pumped. The actual rate, therefore, is $5. When the pumps operate at their full capacity of 25,000,000 gal. per day for 31 days per month, a discount of 50 per cent is made. The city's contract for pumps Nos. 1 and 2 expired on June 30, 1908, but although a new contract was not entered into, the Cataract Power & Conduit Company supplied the energy as before. A new contract will now be made for the three pumps.

## Experience with High-Efficiency Lamps in Industrial Plants.

BY WARREN H. MILLER,

*Electrical Engineer, Standard Oil Company.*

IN one of the large industrial establishments of the country, containing some 45 buildings, besides numerous process tanks and stills, spread over several hundred acres of property, it was decided to use large gas engines as prime movers, and 25-cycle generators because of numerous advantages in paralleling and in motor drive. The problem of lighting this establishment with the least energy appeared to find a ready solution in clusters of tungsten and tantalum lamps, since they eliminated all carbon-renewal charges and all fire risks. To get some data on works street lighting with them, an experimental station of four poles, 80 ft. apart, in a straight line, was erected down the center of a very busy "yard" between the pipe shop and boiler shop. At a height of 35 ft. from the ground on the two end poles were hung two flaming-arc lamps, which were thus spaced 320 ft. centers. These had been tried out and found feasible on 25 cycles after numerous unsatisfactory experiences with the standard blue arc on the same frequency. The flaming arcs showed no perceptible flicker on outdoor service and their motor-driven mechanism proved steady and reliable on the low frequency. It might be mentioned in passing, however, that for indoor service, except for some such large building as a power house, they showed considerable flicker, due apparently to interference of the light reflected from the walls.

These two flaming arcs operated in series and took 12 amp. Tested against them were four clusters of 60-watt tungsten lamps, four lamps in a cluster, making 200 cp for each or 800 cp altogether. As the flaming arcs were rated at 3000 cp each, it was a great surprise to find that, for all practical working purposes, the tungsten clusters gave a far better light. This was due to the light distribution, which was quite brilliant under the flaming arcs, but, even at a height of 55 ft., was so poor midway between the lamps that no workman would handle either steel or pipe. The tungsten clusters gave a brilliant whitish-yellow light which was nowhere dim, owing to there being four of them on 80-ft. centers, against two flaming arcs on 320 ft. centers.

Further tests between two tantalum clusters of four 80-watt lamps and two tungsten clusters of four 60-watt lamps showed that the former gave much better distribution of light because the lamps were spread at an angle instead of hanging vertically in a close bunch. This latter arrangement renders nearly one-third of the glowing filament of little use, as its light is cut off by the adjacent lamps. To obviate this difficulty and yet retain the low power consumption of the tungsten filament, single street lamps were tried in place of the clusters, using the large 250-watt lamp costing about $4.87. Of four of these shipped to the plant two arrived with broken filaments, one went out the first night and the other was stolen out of the socket after a few days' service. Their use was decided against since every such accident would leave the spot in total darkness and lay off a gang of workmen temporarily.

The standard street lamps finally chosen consisted of four 60-watt tungsten weatherproof clusters made by the Federal Electric Company and screwed into Clinton street fixtures. These gave excellent light distribution and illumination when placed on alternate poles 18 ft. from the ground along the works streets, and spacing about 200 ft. centers. The tungsten lamps lasted better there than in many other places, but the percentage of breakage was quite high, one-fourth of all the lamps going out in the first few months. They are being replaced as they burn out with the more durable tantalum filament.

For lighting the manufacturing shops where the vibration is considerable, tantalum 80-watt lamps are used in four-lamp Harter slag-glass clusters with 16-in. white-enamel shades. These were spaced about 30 ft. centers, 12 ft. from the floor, and gave a brilliant white illumination that was in refreshing contrast to the blue-arc illumination usually used in such shops. They were installed 10 months ago and some of them are still in service, the shops having run night and day since starting. The majority of the lamps have been replaced once. In many cases the new lamp was a tungsten, as for all practical purposes they have been found to last quite as well burning on the side or at an angle as when perpendicular. The first lamp to undergo this test was a French tungsten, which was put in a machine-shop cluster on Aug. 6 last and was still burning on March 30.

These shop clusters were home-made and consisted of a steel outlet box with a 3-in. canopy cover, a ½-in. crowfoot, a 3-in. black iron canopy to slip ½-in. pipe and a stem of ½-in. galvaduct conduit into the end of which was screwed the Harter cluster, which has its own shade holder. The current consumption of each cluster was about 3 amp, and the total for

lighting all the shops, including all portables and machine drops. was under 10 kw. This covered a boiler shop, 270 ft. x 125 ft.; machine shop, 110 ft. x 60 ft.; pipe shop, 80 ft. x 50 ft., and carpenter shop, 60 ft. x 50 ft. All machine and bench drops contained 20-cp Gem filament lamps. As for the alleged flicker on 25-cycle lamps it was absolutely indiscernible; indeed, all the lamps were fed temporarily from the exciter sets and later from 110-volt, 25-cycle transformers without anyone in the works being aware that any change had been made in the source of energy. Placed side by side, it was impossible for the most skeptical layman to tell which was which.

Many of the process buildings require absolutely fireproof marine installations and are wired with rigid conduit and marine fittings and fixtures. In these were installed 25-watt, 20-cp tungsten lamps and here the tungstens showed a somewhat lower percentage of breakage and had a long life. Where the fitting needed to be only vapor-proof, but not guarded, the Burnet Company's fixture was used. This takes a 40-watt tungsten, giving a larger lighting unit, and where installed on a secure fixture, such as the lower chord of a pump-house roof truss, shows good results. Lamps put in such places during last December are still burning and have practically no breakage reported against them. But where there is any chance of shocks or disturbance, such as wind storms shaking street clusters, and hammering vibrations being communicated through steel piping to the fixture, the breakage of tungsten lamps is so high as to preclude their use. Tantalum lamps are but little better where powerful vibrations can reach them. Out of 24 put in Harter clusters in the power-house roof trusses, seven broke the first night, and not over five of them are burning at present. But the worst destruction of tungsten lamps was in and around the process stills and tanks. Here general illumination was wanted and the fire risk precluded the use of arcs. As there was no place for poles or light lines, the iron platforms over the still benches were utilized. These were guarded by pipe hand railings and, at intervals of about 50 ft., the rail stanchions were carried up to form arches over the alleys. In the lower leg of one of the stanchions was put a 1½-in. Y rail-fitting, looking downward, and connected to the condulet tee in the ¾-in. galvaduct main of the lamp feed wires. A tee looking down was put in the center of the pipe arch or cross-piece, and a short length of No. 14 duplex wire was fished from there to the Y, where it entered the conduit.

Into the tee in the arch was screwed a Tidman hood with special 5-in. globe, making it capable of taking lamps up to the 100-watt tungsten size. The Tidman hood has a ½-in. thread to screw into stem or nipple, and a ⅜-in. nipple inside which takes a ⅜-in. key socket of any make so long as it permits the wires to be pulled through and fastened after the socket has been screwed on. This type of lighting fixture worked in well with the pipe railing around the process stills, making a strong and durable installation, and was used all over the plant.

When first installed a 100-watt tungsten lamp was put in each, but the slaughter among them was fearful, there being only 15 of them left burning after a few months' service. The filament is far too brittle. For instance: If a gang of pipe fitters in taking a piece of 12-in. pipe along the platform should set it down none too gently on either the railing or the iron floor itself every tungsten lamp within 50 ft. of the jar thus caused would be extinguished. The writer has even seen a pipe fitter set down a pair of 6-ft. tongs on the rail and put out the tungsten lamp in the next arch. A boilermaker's apprentice walking along the platform and beating a tune on the railing, boy-fashion, with a hand hammer would put out every tungsten lamp on the platform. The old carbon-filament lamp is not in the least affected by these trivial incidents, which are so common about a big industrial plant. Tantalum lamps were tried next and were but little better, 16 out of 100 being lost in less than two weeks. At present 50-cp metallic-filament lamps are being used and give no trouble.

The 20-cp metallic filament is the standard shop lamp of these works, there being about 1700 of them in service and only the ordinary shop percentage of breakage is reported. The complete installation of each shop "drop" includes a steel knockout box with cover which just passes a steel rosette bushing for armored cord. Inside is a Bryant rosette into which is secured the steel bushing. As many feet of the flexible armored cord are used as the case may require, and it terminates in a ⅛-in. steel-socket bushing which screws into a No. 1 Edison key socket. The lamp is furnished with a "neverbreak" lamp guard. The "Type E" cord costs only about $10 per 1000 more than the ordinary lamp cord, and is proof against being injured when stepped on, abraded with the cutting edge of a boiler plate, or frayed when yanked into a rough cylinder casting.

The Benjamin vapor-proof fitting consists of a cast-iron box, threaded in four lugs, containing a receptacle and provided with a metal holder like a preserve-jar top which is rigidly secured to the cast-iron box with screws and a rubber gasket. The globe, which is about 4 in. in diameter by 8 in. long, will take a 40-watt tungsten and screws down on a washer inside the preserve-jar top. This fitting is handy to install in a line of conduit, allowing junction from it in two directions and providing a brilliant lighting unit in itself.

The Burnet special marine box is of the same model as the standard marine fitting, except that the box and neck are of cast iron instead of brass, thus making it cheaper, although quite as serviceable. The question of portables involved getting, if possible, an armored cable that would be absolutely chemical proof, especially at the box and the fitting. There appeared to be nothing on the market that would prevent leakage between the armor and the insulation where both entered the fitting, so the standard marine cable was employed with marine portables. These have a bushing and rubber stuffing-box in the handle which absolutely prevents any leakage into the fitting.

It might be well to point out that certain types of flaming arcs with motor-driven feeding mechanism operated very smoothly on 25-cycles, whereas lamps with solenoid control were unsatisfactory on this frequency. The flicker due to the low frequency was not at all disagreeable out of doors, but inside of small buildings or near walls the light would hardly do to work by. In a large erecting shop and in a power house, 400 ft. long, three of them displaced 10 ordinary arcs each, and gave no annoyance from flicker. However, to avoid the high expense of flaming-arc carbons the clusters of incandescent lamps were used. These now hold four 50-cp metallized-filament lamps in place of the 60-watt tungstens originally installed, due to breakage caused by the street fixtures shaking in storms. On 200-ft. centers, 18 ft. from the ground, the illumination is very good and well distributed and requires from 2 amp to 3 amp per fixture. When this was written, of 112 sockets in these fixtures, 28 lamps are useless and 58 60-watt tungstens are burning out of the original 112 installed in January.

Looking over the reports of breakages since last October the tungsten-lamp sheet shows practically none left of such tungstens as were used to replace tantalums in the machine shop, boiler shop, two power houses, two boiler houses, pipe shop and carpenter shop. The tungstens only muster five lamps in all these places put together, while the tantalums in the clusters aggregate 76, some of them burning since May last. In the process buildings where the lamps are mostly mounted on brick walls in guarded marine fixtures the tungstens hold their own fairly well, 237 lamps being still burning, showing an average breakage of about 30 per cent of all the lamps installed in these places. Over 200 tungstens are charged to breakage in moving them from one socket to another. This positively cannot be permitted anywhere about industrial works with tungstens. When once the lamp has burned for a day or so the filament becomes so brittle that it is difficult to move it to another socket without breaking the filament even with the most careful handling. A "lamp famine" in any department thus becomes a calamity unless the new tungstens arrive in time. On 25 cycles the tantalums are quite as bad in this respect. In the brief but glorious history of the 24 tantalums which went into some clusters in the main power house, the reader will recollect that seven went out the first night.

In a month more only eight remained, and when these were ordered out to be used where there would be less vibration, the electrician returned from the roof trusses with the eight and found only one good one left when he reached the ground. It is, of course, due to the well-known faulting of the filament on alternating current, which is very bad on 60 cycles and 133 cycles and also comes in on 25 cycles. The table below of all sizes of tungsten lamps purchased between Oct. 2 and Jan. 26 may throw light on these lamps, as used in a large manufacturing establishment manned by several thousand clumsy, two-fisted mechanics.

TUNGSTEN LAMPS. PURCHASED BETWEEN OCT. 2 AND JAN. 26.

| Size. | Number placed. | Number burning April 2. |
|---|---|---|
| 100-watt | 96 | 20 |
| 60-watt | 550 | 215 |
| 40-watt | 540 | 124 |
| 25-watt | 540 | 30 |

TANTALUM LAMPS. PURCHASED MARCH 17, 1909.

| Size. | Number placed. | Number burning April 2. |
|---|---|---|
| 80-watt | 100 | 84 |
| 50-watt | 200 | 179 |

## Steam Consumption Tests of a 500-Kw Turbo-Generator Set.

By A. C. Scott.

The tests recorded below were made upon a 500-kw steam turbo-generator supplied by the Allis-Chalmers Company to the Water, Light and Power Commission of Austin, Texas.

The turbine is of the horizontal "reaction" type, having the revolving field core of the three-phase alternator connected thereto by means of a flexible coupling, which is intended to provide for slight inequalities in the wear of the bearings, to permit axial adjustment of the turbine, and to admit of differences in expansion.

The four bearings, two on the turbine and two on the alternator, are self-adjusting, with relatively large bearing surfaces, and are lubricated by a constant stream of oil flowing into the middle of each and out at the ends. The oil is maintained at a pressure of about 2 lb. per square inch to insure a sufficient

FIG. 1.—STATIONARY ARMATURE OF TURBO-GENERATOR.

flow through the bearings by means of a rotary pump driven from the turbine shaft. This pump maintains an oil pressure of about 20 lb. per square inch for the control of the throttle valve by the governor, and this valve is decreased to the required pressure for the bearings by a reducing valve. The oil is circulated again and again through the bearings, being cooled by water after passing from the bearing before reaching it again. A noteworthy feature in this connection is the sectional brass oilers having glass sides, so that the stream of oil flowing into a bearing is visible at all times.

Where the shaft of the turbine passes out of the cylinder, the inward leakage of air or outward leakage of steam is prevented by glands which are kept tight by water packing and are therefore practically frictionless. A water pressure of about 10 lb. per square inch is maintained continuously, and the leakage passes through with the condenser discharge.

The gland water pressure in this particular plant is maintained by pipe connection with a tank 48 in. x 30 in. x 30 in. in size, located in the top of the boiler house, the pure water supply to which is controlled by a ball compression cock. Gages

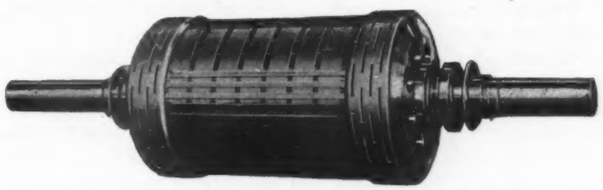


FIG. 2.—REVOLVING FIELD STRUCTURE OF TURBO-ALTERNATOR.

on the turbine show the pressure at all times and readings are included in the following data under the term "gland" pressure.

The governor of the turbine is driven from the turbine shaft by cut gears running in an oil bath, at a speed ratio with respect to the turbine of 4:29. The governor operates the balanced throttle valve by means of an oil relay, and responds very satisfactorily to variations in load. It may be adjusted to change the speed of the turbine while in operation and thereby facilitate the synchronizing of the alternators and proper division of load.

An auxiliary governor is attached directly to the turbine shaft and rotates at the same speed. This governor is adjusted for a predetermined speed of the turbine, and should it reach a value far in excess of that, a valve is tripped which shuts off the steam and stops the turbine. A test of the safety governor was made, and is later described.

To provide for possible overloads that may be thrown upon the turbine, a by-pass steam valve which admits boiler pressure steam at a later stage in the turbine where the blades are larger, is actuated by the main governor whenever the load becomes abnormal. The "inlet" pressure gage readings appearing later on in the data on the test indicate the bypassing of steam on the heavy load.

The cylinder of the turbine is covered with insulating material and lagged with planished steel. The revolving field coils of the generator consist of flat copper placed in radial slots of the iron core. These coils are held in place by means of manganese-bronze wedges, the whole presenting a smooth surface cylinder (Fig. 1). Ventilation of the coils and core is accomplished by air being drawn in through openings parallel with the axis and discharged at the periphery. The ventilation of the ends of the coils is attained by allowing them to project beyond the ends of the core, they being held firmly in place against the stress of centrifugal force by means of nickel-steel rings. The stationary armature has numerous air ducts for ventilation of the laminated core and winding (Fig. 2).

The cool air is drawn in at the sides of the machine by means of fans which discharge it over the end connections of the armature coils into the base of the machine whence it passes through ventilating ducts in the core to an opening at the top of the cast-iron frame. The over-all length of turbine and generator is about 23 ft. 4 in.; width, 4 ft. 8 in.; height of highest point above floor line, 5 ft. 4 in., and total weight, 40,000 lb. The diameter of the steam pipe at throttle is 5 in., and of the circular exhaust opening 24 in.

The condenser in use with the machine tested is of the surface type, was built and furnished by the Henry R. Worthington Company, and consists of 2000 sq. ft. of cooling surface in the form of ½-in. copper pipes through which the circulating water is passed.

Two two-stage turbine pumps, driven by three-phase motors, pump the circulating water for all the condensers in the plant,

the inlet and outlet mains on the condenser for the turbine being each 10 in. in diameter.

The condenser discharge is pumped to the hot well by means of a motor-driven two-stage Worthington pump of about 3-hp full-load rating.

A Knowles rotative dry-vacuum pump is in use with the turbine, of dimensions 6 in. x 10 in. x 12 in.; piston rod, 1.25-in. diameter. The results concerning speed and steam consumption of this pump are considered later.

The exciter for the turbo-generator is an Allis-Chalmers machine, rated at 120 volts and 187 amp, directly connected to a 6-in. x 6-in. double-cylinder American Blower Company engine running at 512 r.p.m.

Since the tests were to be conducted at unity power factor load, it was decided to use a water rheostat for loading the generator. The size of the rheostat was calculated approximately by determining the heat units to be dissipated at 625 kw, which was 1¼ load for the machine. The box was made 8.5 ft. x 7 ft. x 2 ft., with a post in the middle, one at each of two corners, and one at the center of one end. The outer posts were connected to the middle one by wooden tracks which allowed each of the three electrodes used to be moved forward or backward along the bisectors of the angles of an equilateral triangle.

This arrangement permitted the load to be balanced easily and quickly. The electrodes used were ¼-in. boiler plate, of 12 in. x 12 in. size and for the ½-load test had to be raised nearly out of the water, causing the load to be a little unsteady. For each of the other tests, however, the load was readily maintained balanced and steady, and for the 1¼ load the plates were wholly immersed and a ¾-in. stream of cold water flowing into the box kept the water level constant at the top, with such satisfactory results as to leave nothing better for the work to be desired. Fig. 3 shows the appearance of this water rheostat while the test was going on.

| Load (apparent, part of full-load) | 0 | 2/4 | 3/4 | 4/4 | 5/4 |
|---|---|---|---|---|---|
| Load, actual, kw | 0 | 217.5 | 371.9 | 490.4 | 606.8 |
| Pressure at throttle, lb | 148.5 | 149.7 | 146.6 | 146.0 | 148.1 |
| Steam quality, per cent | 99.00 | 97.99 | 98.50 | 98.55 | 98.70 |
| Steam per hour, lb | 1583.1 | 5417.4 | 7968.0 | 9654.6 | 11888.2 |
| Steam, lb. per kw-hour | —— | 24.9 | 21.4 | 19.7 | 19.6 |
| Corrected consumption | —— | 24.0 | 20.67 | 18.5 | 18.4 |
| Speed, r.p.m. | 3614 | 3596 | 3579 | 3568 | 3565 |

An analysis of the heat units required for operation at five-quarters load shows that the total of 14,236,476 lb.-Fahr. units per hour used by the turbine and auxiliaries were distributed as follows:

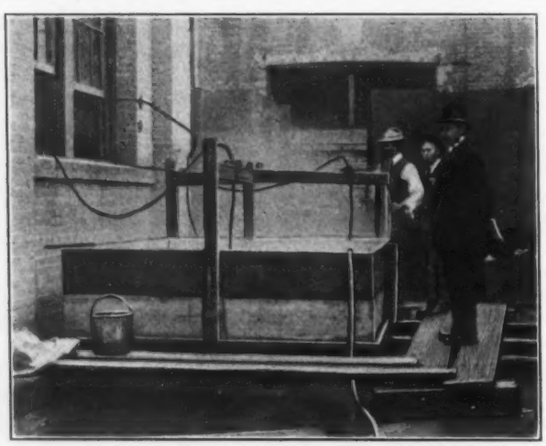


FIG. 3.—WATER RHEOSTAT.

| | | | |
|---|---|---|---|
| Driving dry-vacuum pump | 6,590 units | = | 0.05 per cent |
| Removing condenser discharge | 5,209 units | = | 0.04 per cent |
| Circulating cooling water | 18,592 units | = | 0.13 per cent |
| Steam at throttle | 14,236,476 units | = | 105.07 per cent |
| Total | 14,266,867 units | = | 105.29 per cent |
| Returned by condenser | 717,870 units | = | 5.29 per cent |
| Used by turbines and auxiliaries | 13,548,997 units | = | 100.00 per cent |
| Delivered at the switchboard | 2,056,221 units | = | 15.17 per cent |

The change in speed from no-load to full-load was 1.3 per cent; when the main switch was opened under full-load the speed increased by 4.0 per cent and the e.m.f. by 25.4 per cent. At a constant speed and normal e.m.f., the speed regulation is 15 per cent. The temperature rise after operating for 1.5 hours at 1.25 full-load was only 26.7 deg. C. as measured at the air blast.

Tests of the unit were made at no-load, half-load, three-fourths load, full-load and five-quarters load. At no-load the steam pressure at the throttle was 148.5 lb. and the quality of steam 99 per cent. The condenser discharge was 2211.6 lb. per hour, of which 612.5 lb. was gland water. Thus, when connection is made for the quality, the consumption is found to be 1583.1 lb. per hour.

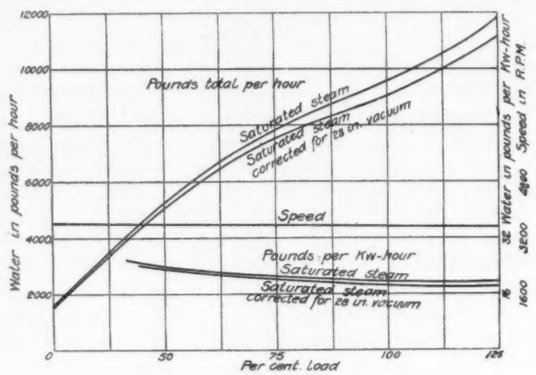



FIG. 4.—PERFORMANCE CURVES.

At one-half load the throttle pressure was 149.7 lb. and the average quality of steam 97.99 per cent. The actual load was 217.5 kw, the total corrected consumption being 5417.4 lb. per hour, or 24.9 lb. per kw-hour. The vacuum was 27.4 in.; for a vacuum of 28 in. the steam consumption would have been 24.0 lb. per kw-hour.

At three-quarters load the steam pressure was 146.6, the average quality of the steam 98.5 per cent, the vacuum 27.4 in., the load 371.9 kw. The steam consumption was 21.4 lb. per kw-hour, corresponding to 20.67 lb. per kw-hour with a 28-in. vacuum.

At full load the steam pressure was 146.0 lb., the quality 98.55 per cent, the vacuum 27.0 in., the real load 490.4 kw. The steam consumption was 19.7 lb. per kw-hour, or 18.5 lb. per kw-hour when corrected for 1-in. low vacuum.

At five-quarters load, the pressure was 148.1 lb., the quality 98.7 per cent, the vacuum 26.92 in., the real load 606.8 kw. The steam consumption was 19.6 lb. per kw-hour, corresponding to 18.4 lb. at a 28-in. vacuum.

These results are shown in Fig. 4 in order that they may be compared more readily.

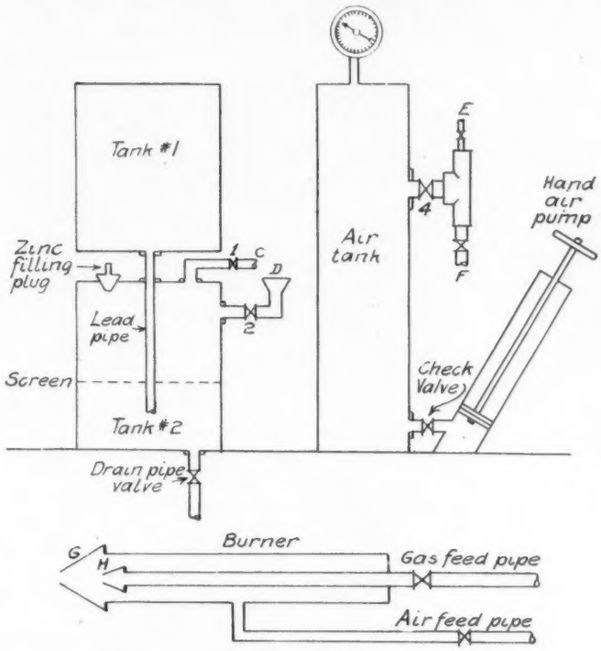
## The Installation and Care of Storage Batteries.

By Omer F. Dubruiel.

In setting up a storage battery care should be taken to have the battery-room light and dry, and the battery should be placed in a position that will allow each cell to be easily examined. The space above the battery must be sufficient to allow the plates to be taken out and put in again. If there are not enough windows for the admission of air artificial ventilation should be provided. Shafting, pipes or anything metallic situated over the battery should be covered or painted so that there may be no danger of any scale or rust falling into the cells. Windows through which the sun's rays may reach the cells should be painted white.

After a firm and level battery foundation has been prepared, the jars or tanks should be placed in position. If a few small glass jars are used they may be placed on shelves. Larger cells should be placed in sand trays and insulated by glass petti-

coat insulators. If the elements are in lead-lined tanks they should also be insulated with glass or porcelain petticoat insulators. After placing the jars or tanks in position, the elements are inserted. If glass jars are used, the hangers rest directly on the edges of the jars; and if lead-lined tanks are employed, the hangers rest on pieces of glass which are placed edgewise in each side of the tank. Before placing the elements in position, treated wood separators should be placed on the positive plates, two or more of the separators being used on each plate, the number being dependent on the size of the




FIGS. 1 AND 2.—DETAILS OF TANK AND BURNER.

element. All the hangers on the different plates should be of a uniform distance apart and no parts of opposite elements should be allowed to touch.

Small and moderate-size cells are provided with lead straps for connecting together with bolt connectors. These should be scraped bright and bolted up tightly, but not with too much force, as owing to the material used for making the bolts noncorrodible they are not as strong as iron ones. After the battery has been connected up several days, the bolts should be again tightened and painted with special asphaltum paint. The lead terminals should be permanently connected by "burning" them, but when this is not possible they should be soldered, mutton tallow being used as a flux. Under no circumstances should muriatic acid or soldering salts be used.

In burning the terminals the best flame to use is the hydrogen flame, as it may be used without any flux. For this a hydrogen generator is necessary and one may be made up as follows: Referring to Fig. 1, tanks Nos. 1 and 2 are lead lined and connected by a lead pipe. Tank No. 2 is fitted with a plug for zinc filling, and is also fitted with a pipe and valve connecting No. 1. In pipe *C*, on the side of the tank, a pipe, valve and funnel are arranged to allow the charging of diluted sulphuric acid. Tank No. 2 is also fitted with a drain pipe and valve. In order to charge the generator the plug is removed and pieces of zinc inserted. The zinc is held by the screen indicated by the dotted line. Then the dilute sulphuric acid is placed in the funnel *D* and valve No. 2 is opened (valve No. 1 and the drain valve being closed). The plug should be replaced and valve No. 2 closed when the sulphuric acid has risen to a height of 1½ in. above the zinc resting on the screen.

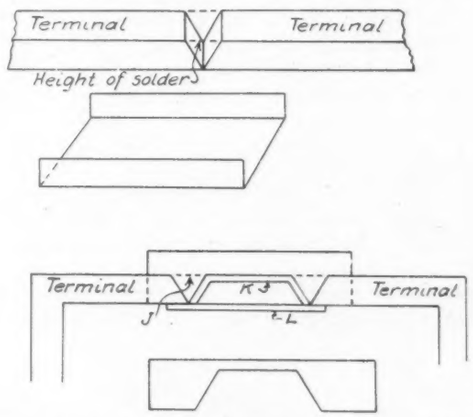
The acid attacks the zinc forming zinc sulphate and liberating hydrogen. As the gas is generated and fills the space above the acid in tank No. 2 the pressure of the gas upon the acid forces the latter up the lead pipe into the tank No. 1. When the gas is used the pressure drops and flows down the pipe and again comes in contact with the zinc and in this manner keeping a pressure of 2 lb. to 4 lb. per square inch. Fig. 1 also shows an air tank and hand air pump and gage.

Pressure is put on the air tank, and by means of a rubber hose, connections from valve *E* or *F* are brought to the burner, as shown in Fig. 2. When using air from the tank valve 4 should be opened and a connection made from *C*, Fig. 1, to the gas pipe in Fig. 2. Fig. 2 shows two leading-in pipes, one for gas and one for air; these have tips connected to them in order to get different size flames, the air and gas being regulated by valves. Fig. 3 shows how the ends of the terminals should be beveled besides being scraped clean and bright. A trough, as shown in Fig. 4, with an interior cross-section equal to the cell terminal, should be used, and by placing the two lugs into the trough and holding them in by means of clamps a chamber is formed into which molten solder may be run. When the cell terminal is of large size the terminal is usually connected to a busbar, as shown in Fig. 5, where *K* represents the busbar. A plate *L* is located under the busbar and terminals and a sheet-iron guard (Fig. 6) is placed as shown and held by a clamp. There are two pieces used, one on each side, and the molten solder is poured in to the height shown by the dotted line *J*. Each lug is treated in the same manner.

Pure lead should be used and the solder should be molten from the bar and allowed to drop in the chamber. At the same time the flame should be kept on the terminals so as to heat them to a point just below melting. The solder will then unite with the terminal and thus make a continuous piece of metal. Great care must be taken not to apply too much heat to the lugs when burning them to the busbar or the lugs will melt before the busbar is sufficiently hot, the latter requiring more heat than the lugs.

When using the burner an inner blue and well-defined flame is noticeable. The best results are usually obtained by holding the point of this blue flame on the surface of the work to be burned. When burning lugs a large flame should be employed, but when burning seams a small flame should be used. After the metal has cooled the clamps and troughs may be removed and the connection dressed for appearance.

Before filling the jars or tanks with the solution, all of the connections between the different cells of the battery and between the battery and the charging apparatus should be made so that there may be no delay in charging the battery immediately upon filling. The electrolyte should nearly fill the jar, and should in all cases cover the tops of the plates at least 1 in. The solution should be absolutely pure. If it is neces-




FIGS. 3, 4, 5 AND 6.—TERMINAL AND GUARD DETAILS.

sary for the user to prepare his own solution, it can be made by using pure sulphuric acid, 66 deg. Baume, and distilled water, 1 part of acid to 5 parts of water by bulk. In mixing an earthenware or lead-lined receptacle should be used. The acid should be poured into the water, and not the reverse. The solution should be stirred with a wooden ladle and allowed to stand until it is cool, after which it is tested with a hydrometer.

The specific gravity should be 1.200, or 25 deg. Baume. If below 1.200 more acid should be added, and if above 1.200 sufficient water should be poured in to bring it to the correct density.

The charge must be commenced as soon as the cells are filling with solution. The battery should be charged at the rate equal to two-thirds of its normal or eight-hour charging rate, and the charge continued until the voltage of each cell is 2.6 volts, the reading being taken while the battery is being charged at the above rate. After the cells have reached the voltage specified, or higher, the charge should be continued until the specific gravity of each cell ceases to rise or has remained constant for at least three hours. This may happen after a battery has been charged for 30 hours or for 60 hours, depending on the type of plates used. If any cells do not show the proper rise in voltage, or do not gas freely, they should be examined for internal short-circuits. If there are any, they should be removed at once and the charge continued until all the cells indicate as above stated.

In charging in regular use the voltage need not reach as high a point as in the first charge except at stated intervals. Once each month the voltage of each cell should be brought up to 2.6 at normal rate, and all the cells made to gas. The tension of the charging circuit should be approximately 5 volts higher than the product of the number of cells multiplied by 2.6 in regular use. The battery should be charged at the normal, or eight-hour, rate if possible, although it is permissible to charge at a higher rate if absolutely necessary. The battery should be completely charged, but should not be habitually overcharged. If this is done, the life of the battery will be shortened and the electrolyte will evaporate rapidly, making it necessary to add water more frequently. If for any reason the battery is used only occasionally or the discharge is at a very slow rate, a weekly charge should be given to freshen it up. The amount of electricity supplied to the cell should exceed the previous discharge from 12 to 15 per cent in amp-hours.

When the cells are all in a normal condition, the maximum voltage and maximum specific gravity of the electrolyte are reached with the charging current constant at the normal rate, when no further rise or increase in either voltage or specific gravity is noticed during a period of one-half hour. In other words, if the charging has been continued for seven hours with a gradual rise in the voltage and specific gravity, and an additional half-hour of charging shows no further rise in either, the battery may be considered charged.

The voltage at the end of charge varies somewhat throughout the life of the battery, the age of the battery and the temperature of the solution having considerable influence upon the same. When a battery is new the voltage at the end of charge will generally be higher than 2.5 volts. As the age of the battery increases, the point at which it is fully charged will be somewhat lower, possibly as low as 2.40 volts per cell. If the charging current is at the highest rate, which should never be used except in cases of emergency, the final voltage will be about 0.05 volt per cell above that for the normal rate. With rates lower than the normal, the voltage at the end of charge will be somewhat less depending on the rate. For instance, if the cell is 2.50 volts at the normal rate, with 100 amp flowing, it will be 2.45 volts at three-fourths the normal rate or with 75 amp flowing. Changes in temperatures affect the final charging voltage by lowering the same when the temperature is above 70 deg. and by raising it when the temperature is below the normal. After a complete charge, and when the charging circuit is opened, the voltage will immediately fall off to approximately 2.15 volts. When the discharge is started it will fall to 2 volts. If the battery is not discharged at once, and is left on open circuit, the voltage will fall to 2.05 volts and remain there.

After the initial charge, and when the battery is regularly put to use, the specific gravity should be between 1.195 and 1.205 at normal temperature with the solution 1 in. above the tops of the plates. A slight and gradual loss of the acid from the electrolyte will be noticed. This is caused by a portion of it being carried off in the form of a spray. When this loss has become such that the highest reading that can be obtained is, say, 10 points below the standard, it should be regained by the addition of dilute acid instead of water. Before doing so one should be sure that the battery is completely charged and that the specific gravity has remained constant for some time. In adding acid to the cell, pure acid should not be used, but one having the same density as that fixed for the proper density of the acid in the cell. It is absolutely essential that the electrolyte should be free from impurities; ordinarily commercial acid should not be used unles it has been subjected to test.

When the battery has been completely charged, in addition to the voltage and specific gravity reaching its maximum, gas will be given off freely from all of the plates. The color of the positive plate should be dark brown, and the color of the negatives uniformly light slate or gray. If the body of the positive plates are of the proper color, no attention need be paid to the lodgment on the top of the plates of a fine white powder that may easily be brushed off. In fact, if the tops of the plates are of the same color as the body and no white powder is noticeable, it is an indication of an overcharge.

The limit of discharge is reached when the voltage has fallen to 1.75 per cell. In regular use it is not necessary to discharge to as low a point as this as it is always found best to have a reserve in case of emergency. After a battery has discharged it should be immediately recharged if possible; it should not be allowed to stand discharged more than an hour. In order to take the proper care of the battery, the attendant should be supplied with a portable low-reading voltmeter reading to 3 volts, but calibrated to 0.02 volt. Two or more hydrometers with scale reading from 1.150 to 1.250 and a portable lamp for inspecting the individual cells, except where wooden separators are employed, when a lamp is not necessary.

On many batteries it is found necessary to use end cells for the purpose of maintaining the voltage on discharge. These are arranged so that they may be successively cut into the circuit on discharge or cut out of the circuit when charged. It will always be found that some of the end cells are seldom used. In this case care should be taken not to overcharge them. They should be brought up to full voltage, the same as the main battery and then cut out. Cells that are not used at all should receive a complete charge once a week.

The amount of charge and discharge can be accurately determined from specific-gravity readings. If the specific gravity in the cell rises, it is unquestionably an indication that the charge is progressing.

It is important that each cell should be regularly inspected and a record made of the inspection. By so doing the chances of a cell becoming low or in a backward condition are reduced to a minimum. It is also essential to have a record to compare with previous ones. In case a cell gets into a low condition, and remains low through two consecutive records, it is a positive indication that something quite serious is causing the trouble. When inspecting a battery all of the plates should be examined. In addition to the examination of the cells with a lamp, and noting near the end of each charge whether all cells are gasing equally well, readings of the voltage and specific gravity of each cell should be taken once a week at the end of a prolonged charge and recorded in a book or in a proper form.

Open-circuit readings are of no value; all readings should be taken at the end of charge while the electricity is flowing. Occasionally readings are taken at other times, but the condition of the cell can be more accurately determined by readings taken at the end of charge. Care should be taken to watch the accumulation of sediment in the bottom of the tank or jar, to see that sediment does not reach the plates, thereby short-circuiting them and causing them to become unhealthy. The sediment should never be allowed to get near the plates. The accumulation is usually the highest under the middle of the plates. For that reason the sediment under all of the plates should be examined. If there is sufficient space provided at one end of the tank, the sediment may be raked out and scraped up. Aluminum scoops are used in lead-lined tanks and wooden scoops in glass jars. If this method of removing sediment is

impracticable owing to the limited space at the end of the tank or jar the sediment may be removed by first drawing off the electrolyte into clean vessels, then flushing the cells with water (the local supply may be used for this purpose). While the mud is being agitated from the flow of the water into the tank it should be either pumped or siphoned out of the cells. If there is not enough drop to use the siphon a pump may be used. After the cell is empty and cleaned, the electrolyte must be immediately restored or undue heating and drying of the plates will occur. The electrolyte should have a density equal to that fixed for the proper density of the solution in the cell. Before cleaning out the cells they should be fully charged.

There are several different causes for short-circuits. A short-circuit may arise through direct contact between adjacent plates; through some conducting material, such as a piece of lead, solder, spongy lead or oxide of lead sticking between the plates; through direct or indirect contact with the lining of the tank; through foreign particles getting into the cells, such as wood, straw, fibers, plaster, etc.; by the accumulation of sediment in the bottom of the jars or tanks; by the accumulation of lead dust on insulators that are not in a vertical position, and occasionally fine particles which are not noticeable at first may bridge across, growing larger, and become short-circuits.

It is of absolute importance for the satisfactory working of the cells that the positive and negative plates be insulated from one another completely. When a short-circuit is sufficiently large to allow the discharge of the cell to pass through the same, the elements will unquestionably get into an unhealthy condition. The cell may be low in voltage as well as in specific gravity and may refuse to gas. It is the duty of the attendant to examine the cells very carefully toward the end of the charge to make sure that all the cells gas simultaneously.

Any cell that does not gas as soon as the others should be examined at once. A portable incandescent lamp is indispensable for inspecting cells other than those fitted with wooden separators. If the cells are not very deep an ordinary incandescent lamp with a reflector on one side to protect the eyes from the light may be used. If the cell is deep it will be necessary to use a small flat lamp that will pass freely between the plates. It must first be ascertained whether all the spaces between the plates are clear. If there is no substance reaching across from plate to plate the insulators should be examined and placed in a vertical position. If the insulators become displaced or the hangers supporting the plates come in contact with one another this must be remedied by moving the insulators into proper position and spacing all the hangers equally. The examination and treatment of a cell which refuses to gas must not be discontinued until the desired gasing is obtained. The plates should not be unnecessarily disturbed; whenever necessary to remove particles adhering to the plates which are liable to cause short-circuit, a wooden or rubber strip should be passed between them.

The simplest method of bringing up cells showing a backward tendency is to give the whole battery an overcharge. If this does not bring up the low cells the latter should be prevented from discharging as much as the main battery. Where the cells are bolted together this can be readily accomplished by disconnecting the cell in question after a complete charge and letting it stand until the main battery is discharged, putting it into the circuit again prior to the next charge and repeating this treatment if necessary. Where the cells are lead-burned together it will be necessary to use an individual cell booster to bring them up. This consists of a small motor-driven generator of sufficient voltage to charge the cell. This machine can be charging the backward cell while the main battery is being discharged. Before putting a battery that has been in trouble into regular service again, care should be taken that all of the signs of a complete charge are present; that is, the potential and specific gravity should rise to the proper value, the plates should gas and have the normal color.

In case it is found necessary to discontinue the use of a battery for a period of six months or so it is advisable to take it entirely out of the service by drawing out the electrolyte. This may be done in the following manner: First, give the battery a complete charge, then siphon off the electrolyte into convenient receptacles, preferably carboys, making sure not to use carboys which have had other kinds of acid than sulphuric in them unless they have been thoroughly cleaned. As each cell is emptied of electrolyte it should be immediately refilled with water. The present method used is simply to allow the cells to stand in the water for a period of approximately 12 hours without discharging them while the water is in the cell, after which the water may be drawn off and the battery may stand until once more put in service. In putting a battery into service again it should be treated in the same manner as a new battery and care should be taken that the polarity of the charging source has not been changed in the meantime.

## Submerged Wire Rheostat.

By P. M. Brown.

One very often requires rheostats capable of absorbing large amounts of energy for comparatively long periods, and the question of design has always proved more or less difficult as the little data obtainable were very vague and unreliable. The general method has been to cut and try; a process productive of much waste of time and money to say nothing of patience. On various occasions the writer made experiments with different sizes and types of rheostats, particularly with the immersed wire type, with the idea of finding some basis for calculation. The results may be summed up in the following formulas, which have proved very reliable. They apply only to immersed wire rheostats using ordinary galvanized-iron wire as a resistor. This type is the best for moderate voltages. It is very reliable; gives a steady load at practically unity power factor; is easily and cheaply built, and flexible enough, if a little ingenuity is exercised, to meet the most exacting requirements.

$$d = kI^{\frac{1}{2}} \qquad (1)$$

$$l = \frac{d^2 \times E}{112 \times I} \qquad (2)$$

where $d$ = diameter of wire in mils.
$I$ = current in wire in amperes.
$E$ = e.m.f.
$l$ = length of wire in feet.
112 = a constant = resistance in ohms per mil-foot.
$k$ = a constant having the following values: For tank or barrel rheostats $k = 3.25$ to 2.75. About 5 kw is all that should be dissipated in one barrel, using a plentiful supply of water. Where the rheostat is placed in a tailrace or river with a moderate flow $k = 2.75$ to 2.25. Where the rheostat is subjected to a rapid flow of water at low temperature $k = 2.25$ to 2.

A value of $k$ as low as 1.85 has been used; but is not recommended. The rheostat took the form of a single wire strung zigzag across a rapidly flowing stream. The value of $k$ is dependent upon the quantity of water and its temperature, and has a critical value for each condition where a slight increase of load will cause abrupt failure due doubtless to the formation of a gaseous envelope and consequent failure of the wire.

The accompanying sketches and notes on a rheostat constructed for the acceptance tests of a 2000-kva, 2400-volt, three-phase, 25-cycle, hydro-electric unit may serve as an illustration. The requirements were to test the generator under a load of 2000-kva, 2400-volts unity power factor and under a load of 2500 kva, 2400-volts at a power factor of 80. In the waterwheel efficiency tests, an absolutely steady load, capable of variation from zero up to the full capacity of the turbines, some 3350 hp was necessary, and in the governor tests, a load capable of variation from zero to full capacity of turbines and allowing of abrupt changes of 50 per cent and 100 per cent of load.

It might be noted that the rheostatic load was not a success when used for the purpose of adjusting the governor, as it seemed to lack the cushioning flywheel effect of an ordinary power load and caused the governor to be too sluggish for

ordinary operation. However, that is a fault on the right side and one easily remedied.

The rheostat as shown was mounted on a raft and consisted of six racks of coils connected up into two independent star systems. The racks were held in place by two bolts and any one could be easily removed for examination or repair without disturbing the others or causing more than a few minutes' delay.

The calculations were as follows:

Maximum load = 2500 kw at 2400 volts; 603 amp per phase; 301.5 amp per phase per star system. E.m.f. to neutral = 1385 volts.

A value of $k = 2.45$ was selected, as the rheostat was to be moored in the tailrace in the full flow from the wheels.

Using formula (1), $d = 245 \times \sqrt[3]{301.5^2} = 110$ mils. No. 12 B. W. G. wire (109 mils) was the nearest size.

Using formula (23), the length of wire for this load per rack

$$l = (1385 \times 109^2) \div (112 \times 301.5) = 488 \text{ ft.}$$

For the full-load test on the generator, the current per phase = 482 amp at 2400 volts. The energy current in the 25 per cent overload test has the same value and was well within the capacity of the rheostat. The length of wire to absorb 2000 kw =

$$l = (1385 \times 109^2) \div (112 \times 241) = 610 \text{ ft.}$$

Each rack was wired with 10 coils of No. 12 B. W. G. galvanized-iron wire 61 ft. per coil or 112 turns on 1½-in. iron pipe. Coils were mounted on 1-in. x 1 5/16-in. porcelain knobs and tied with galvanized-iron wire. Leads of No. 4 B. & S. wire were brought out, through 6-in. porcelain tubes in the top of the rack, from the beginning of the first and the ends of the eighth and tenth coils, making the required two sections of 488 ft. and 610 ft. on each rack. All joints were carefully made and soldered and kept at least 6 in. under water. Care was taken to separate all coils at least 1 in. from the framework, and to moor the raft so as to expose all coils to a free flow of water; none being sheltered behind any portion of the framework. The generator tests were made with the full racks connected—two stars in parallel; the quadrature current in the 25 per cent overload test being supplied by a synchronous motor floating on the line.

For the waterwheel test, a single star was first used with full racks and a maximum load of 1000 kw. The second star was next paralleled and finally the taps from the eighth coils were joined to the neutrals, leaving eight coils per rack in service with a total capacity of the rheostat of 2500 kw at 2400 volts. Intermediate loads were obtained by field control.

The governor tests were made with the rheostat connected as in the last part of the turbine test. Control of the load was obtained by regulating the field. Half-load changes were made by opening and closing one leg of a three-phase oil circuit-breaker and minor variations by sudden swinging over the field rheostat.

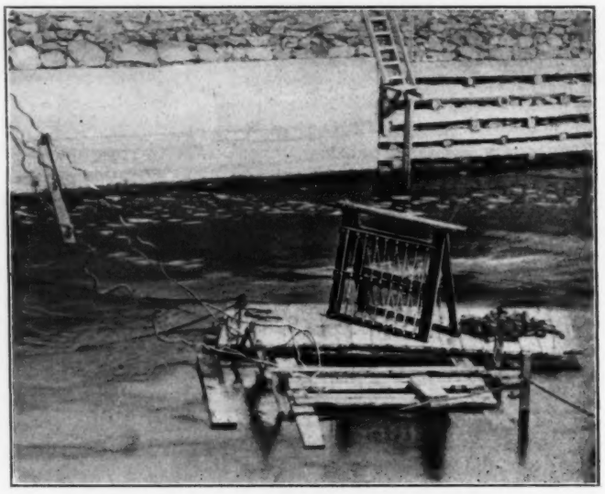


FIG. 2.—RHEOSTAT IN TAILRACE.

With the three taps per rack and changing combinations from star to delta, the following balanced loads could be obtained: 500, 550, 660, 850, 1000, 1250, 1500, 1665, 1880, 2000, 2250 and 2500 kw at 2400 volts. If additional taps be brought out, almost any desired load may be had, though the above are sufficient for any test.

The rheostat was in constant service for over two weeks without any interruption and irregularly for nearly a year as an artificial load. When taken from the water last fall for the winter, it showed little or no deterioration except a little corrosion at the joints, due perhaps to electrolytic action between the copper leads and the zinc coating of the wire. The loads obtained came within 2 per cent of those calculated.

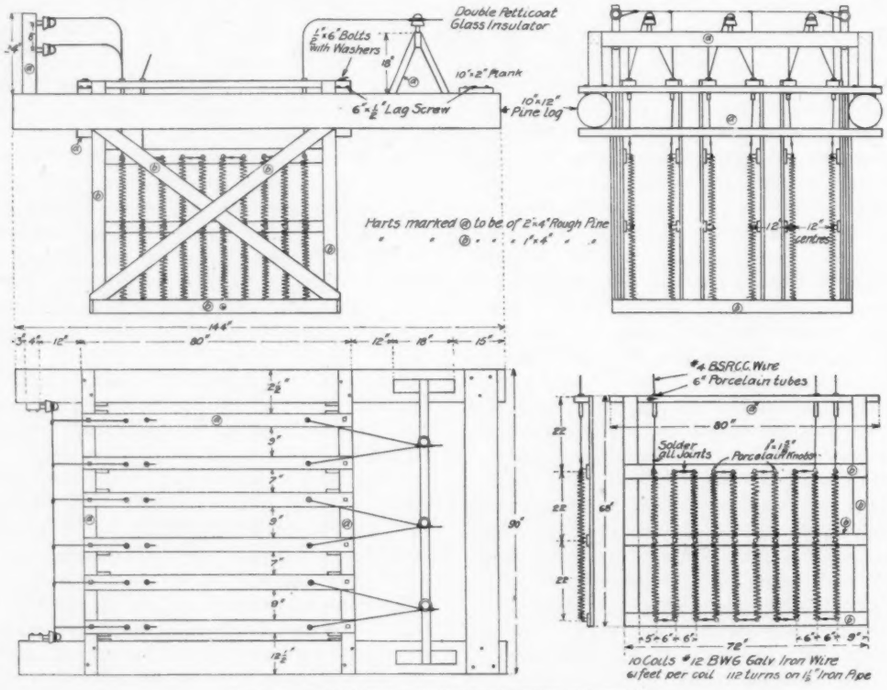

Double Petticoat Glass Insulator
1"x6" Bolts with Washers
10"x2" Plank
6"x½" Lag Screw
10"x12" Pine log
Parts marked ② to be of 2"x4" Rough Pine
" " ③ " " 1"x4" " "
12" centres
#4 B.S.R.C.C. Wire
6" Porcelain tubes
Solder all joints
1"x1⅜" Porcelain Knobs
10 Coils #12 B.W.G. Galv. Iron Wire
61 feet per coil 112 turns on 1½" Iron Pipe

FIG. 1.—DETAILS OF IMMERSED WIRE RHEOSTAT.

## Prime Movers for Small Central Stations.

Mr. T. L. Daniel, of the Minneapolis Steel & Machinery Company, presented a paper on this subject at the Minnesota Electrical Association convention at Minneapolis March 18 and 19. After referring jocosely to the confusion that is likely to exist in the purchaser's mind after the claims for all the different kinds of engines and turbines have been presented to him, he considered the relative merits of four types of prime movers, namely, the Corliss engine, high-speed engine, gas engine with producer gas, and steam turbine. His remarks applied particularly to plants of 500 kw and less.

The Corliss engine, being the oldest engine of the types considered, comes nearest to perfection, and is the best known among operating engineers. In this country it is still the standard for comparing economy, reliability and durability, the two latter qualities always being best with the slow speeds which are characteristic of the Corliss. Small clearance is a condition demanded by steam economy, and the long stroke of this engine, with its peculiar valve and short and direct ports, secure it more successfully than any other kind of reciprocating engine.

The high-speed engine is improving continually in the direction of simplicity and durability, and the manufacturers of really commendable machines seem to be catering to the demand for engines to operate where fuel is cheap or space is at a premium, or exhaust heating is required. The widely prevailing opinion relative to the low first cost of high-speed engines, the author says, is erroneous when one considers really first-class machines of the high-speed type, as they are not much lower in cost than the Corliss.

The producer-gas plant, he said, is particularly adapted to plants where fuel is high in cost or poor in quality, and water is bad or scarce. Its advantage lies in its unequaled economy of both fuel and water, ease of firing, especially with anthracite coal, safety and immunity from serious accidents resulting from careless operation, simplicity and smokeless combustion. Unfavorable to it are its high first cost and large floor space. To get reliability equal to the Corliss engine requires the best possible plant and a contract with the manufacturer to supply a competent operator.

The steam turbine has its field where space is valuable and foundations troublesome. The simplicity of the turbine itself and the absence of reciprocating parts has caused much comment. For plants under 500 kw, however, it is not clear that these properties are of any commercial value. The disadvantages are the uncertainty of repairs and depreciation, involving the possibility of serious damage to the turbine in consequence of some slight neglect; difficulty of securing experienced operators; the great amount of water required; condition of operation and first cost of plant required to give equal economy to the compound-condensing Corliss plant. A non-condensing turbine plant without superheater would cost much less than a steam Corliss plant. Its economy would about equal the high-speed engine, and its depreciation might be a serious matter because of erosion.

In discussing this paper the question was brought up as to the feasibility of adding a low-pressure turbine to operate condensing in a plant already equipped with simple reciprocating engines, thus adding to the output without increasing the boiler plant. It was stated that low-pressure turbines of small size were not feasible for plants under 500 kw.

Prof. George D. Shepardson, of the University of Minnesota, emphasized the desirability of forcing fires and running machinery at overload during the brief peak-load periods which occur each year. For example, the yearly peak in one central station with which he was familiar lasted only 60 hours per year. It was very desirable to keep down the investment on machinery needed to carry such a short peak.

Mr. Ludwig Kemper, of Albert Lea, said that from figures recently quoted a high-speed engine unit can be bought for 30 per cent less than any other kind of unit. The first cost of the steam turbine unit was lower than for a direct-connected Corliss. The amount of oil required for the turbine would also probably be less.

Another member brought up the question as to whether it would be desirable to operate a plant partly with producer-gas engines and partly with steam, having the new machinery of the producer-gas type and retaining the old steam-driven machinery. Mr. Daniel thought that this might be a good plan in some cases, changing the station over to producer-gas by degrees. In answer to a question as to the overload that can be carried by a gas engine, he stated this to be 10 to 25 per cent on engines as built by some makers.

Mr. B. W. Cowperthwait, of Faribault, expressed the opinion that if the gas engine were able to carry an overload of 10 to 25 per cent it would be underrated. The full-load rating of an engine is commonly considered to be its load when giving maximum economy. Mr. N. M. Argabrite, of Winona, said that the full-load rating of steam turbines is the point at which they give their best economy.

Mr. E. W. Erick, of South St. Paul, pointed out that while a steam engine or turbine will carry a load in excess of that at which it will give its maximum economy, this is not so with the gas engine. When the gas is being used in the most economical manner, with the best mixture in a gas engine, maximum load is obtained, and any load in excess of this will slow down the engine, so that the ability of the gas engine to carry load in excess of its rating is due to rating it below its point of best economy.

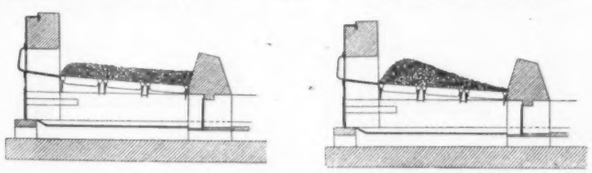
Mr. J. R. Cravath, of Chicago, called attention to the desirability in many cases of operating a mixed steam and gas-engine plant. In such an event the new gas-engine units could carry the all-day load at high economy and the steam units could be kept for reserve and to carry peak loads. This would keep the operating expenses low without unduly increasing the investment, as would have to be done if the prime movers were changed at once to gas engines.

## Methods of Firing Cheap Grades of Bituminous Coal.

BY WM. KAVANAGH.

There are six ways in which soft coal can be fired. These methods are known by the following names: Pancake, wedge or coking scoop, direct mixture, humpback and alternate. The pancake method of firing receives its name from the fact that the bed of coal is kept the same thickness all over the grate-bar surface, as shown in Fig. 1. The wedge or coking system may be employed in one of two ways, as shown in Figs. 2 and 3; the heavy end of the wedge being in the front or rear of the grate as shown. The scoop method of firing is illustrated in Fig. 5; the name scoop being applied because the fuel bed at the center of the furnace is thinnest and is gradually increased in depth as it approaches the furnace walls.

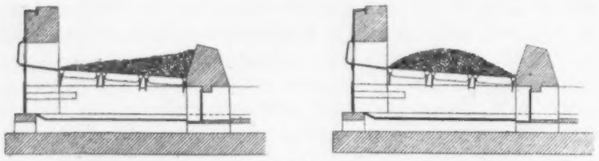
The direct mixture system of firing refers to that method where hard coal dust and soft coal are mixed in certain proportions and then fired either wet or dry according to the experience and ability of the fireman. The name humpback is



FIGS. 1 AND 2.—PANCAKE AND WEDGE FIRES.

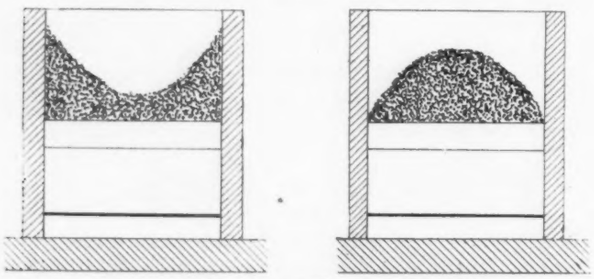
given to that system of firing in which the fuel is carried high or deep at the center of the furnace and then tapers downward toward the bridge wall, furnace door and furnace walls, as shown in Figs. 4 and 6. The alternate method or system of firing derives its name from the way in which the hard and soft coals are fired in alternate layers; the different grades of coal being kept separate outside of the furnace door and each

grade fired in regular order. With this method, the fire is first started with a heavy bed of soft coal and after this bed is well ignited, a thin layer of wet dust is spread evenly over the entire surface of the fuel bed. When the flame has appeared through this bed of hard coal dust, another layer of soft coal is spread over the incandescent bed of dust, and in this way the furnace is almost completely filled with the alternate layers. After the furnace is nearly filled in the manner described, water is sprayed over the surface of the fuel, the furnace door closed and if the firing has been properly done no more coal will be needed during a run of five or six hours' duration, depending on the intensity of the draft and demand for steam. With natural draft this fire will last a long time, exceeding eight hours in some cases. Occasionally during the run a light sprinkling of water over the surface of the fuel will be found necessary partly to solidify the dust and delay rapid combustion. Should air holes appear they must be filled by first throwing one shovelful of soft coal over the air hole and on top of this a shovelful of wet dust. In this way the main body of the fire is maintained during the run. This method of firing is excellent where the plant operates continuously. Smoke formation is practically eliminated and the burning of soft coal can be practised where the most stringent anti-smoke laws are in effect. Occasionally during the run the slice bar may be inserted beneath the bed of incandescent fuel and the bed slightly lifted from the grate bars without allowing the bar to break through the upper surface of the fuel. This will add materially to combustion of the fuel. When the time arrives for a new fire to be built up, the old fire may be cleaned and enough live coal retained to start the fresh soft coal bed, when the firing can be continued as above explained. Very little clinker will be found in the furnace even with the use of the cheapest grades of coal and only a small amount of ash remains to be hauled from the furnace during the cleaning process.



FIGS. 3 AND 4.—WEDGE AND HUMPBACK FIRES.

Wetting fuel is wasteful from a theoretical standpoint; but practically it is known that if the dry dust of either hard or soft coal is used steam cannot be generated in sufficient quantities with ordinary natural draft. The most skilful firemen are unable to obtain practical results from the use of dry dust and hence it is common practice to sprinkle water on the dust employed. This causes it to cake, and afterward when subjected to heat the cakes thus formed coke and form themselves into lumps after the manner of a honeycomb. This honeycomb formation is what the skilful fireman very much desires, and the small loss due to the wetting is offset by the gain due to the cheapness and quality of the fuel employed, and the fact that this cheap fuel can be thus profitably used. It is practically impossible to burn dry dust satisfactorily except by using some form of mechanical draft or by sprinkling it with water in the manner described.



FIGS. 5 AND 6.—SCOOP AND HUMPBACK FIRES.

The direct mixture system of firing is employed in numerous plants and a little experimenting with this system will determine what proportion of dust and soft coal is the most profitable to employ. With two barrows of dust and one barrow of soft coal, the mixing of these fuels can be automatically performed by dumping one barrow of dust, and on top of this one barrow of soft coal and then on top of the soft coal another barrow of dust; each barrow of fuel being sprinkled with water as it is dumped. If it is found the proportion of dust is too great one barrow of each may be used for the next trial and in this way one can determine which proportion is the most economical. Some years ago, hard coal dust was given away and in some cases carted to the boiler room for nothing; but now a load of dust costs from 50 cents to $1 in many cities in the East. The price of soft coal ranges from $3.50 to $4.50 per ton in the same sections, so that it will be evident the more dust burned the more economically steam is generated. Referring again to the direct mixture system, it will be found that some firemen can burn one barrow of dust mixed with one barrow of soft coal, while other firemen can only burn one barrow of dust to two barrows of soft coal. In general it will be found that a good fireman can burn three barrows of dust mixed with two barrows of soft coal on natural draft.

In the wedge or coking system of firing when the thickest end of the wedge is against the bridge wall, smoke formation is sure to occur; the thinnest end of the wedge near the furnace door admitting more air, becomes incandescent long before the fuel at the bridge wall is well ignited. Hence the smoke formed in the thickest portion of the bed passes out to the chimney without encountering any highly heated portion of the furnace. If the wedge formation is reversed, the thinnest end will be raised to a high temperature and the smoke formed near the furnace door must pass over or through this highly heated portion of the furnace near the bridge wall and, therefore, the smoke is consumed before it can appear as such in the stack or chimney. The hottest region of the furnace being furthest from the furnace door the rich gases are ignited and their complete combustion is assured. If a piece of pipe is inserted in the uptake or back connection in such a way as to permit the smoke to flow through it and out in the boiler room it will be found possible to burn the smoke by applying a torch to it. This experiment would indicate that gases rich in carbon were escaping to the stack without being consumed. Combustion of those gases should take place in the combustion chamber and the heat so evolved utilized in generating steam.

## Pipe-Hangers—III.

By W. H. Wakeman.

IN the first issues of March and April, the writer illustrated quite a number of hangers applicable for various purposes, and in the present issue concludes the series with a description of 10 others.

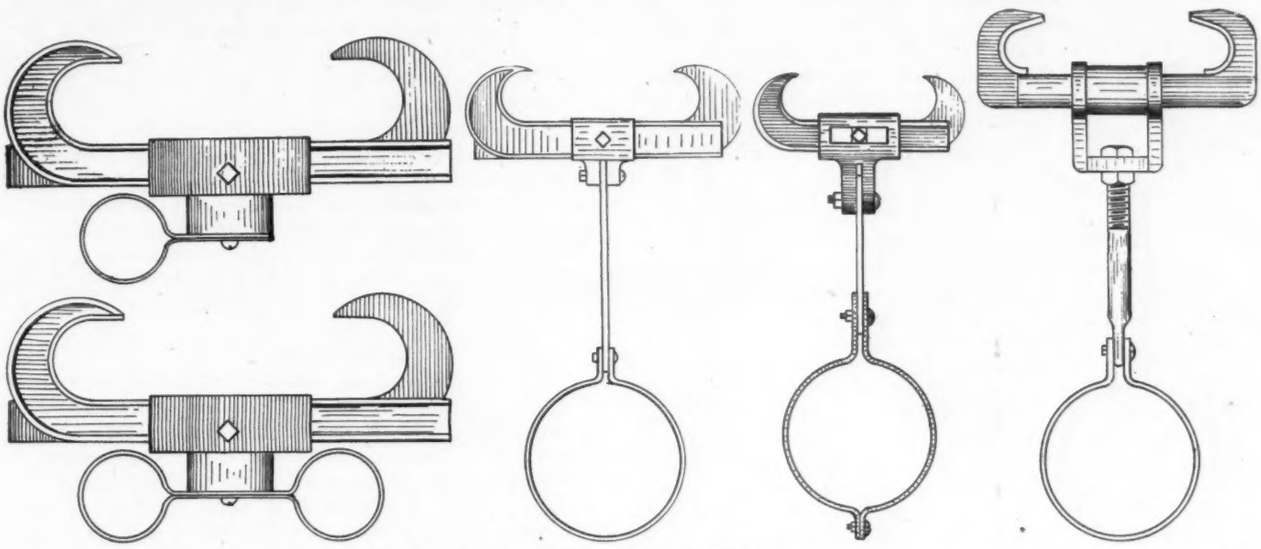
The hanger shown in Fig. 1 can be nicely adjusted to beams with flanges from 3 in. to 7 in. wide, as the straight shanks of the hooks are a sliding fit in the central part, and when in proper place they are fastened by the set screw shown. This device is for one pipe only, but that shown in Fig. 2 carries two, and in both cases they are close to the ceiling. It is not necessary to place the pipe parallel to the hanger, as the supporting rings are on a swivel, therefore, they can be turned at any desired angle.

Fig. 3 illustrates another girder hanger for pipes, the lower part of which consists of a bar or link of flat iron that can be coarsely or approximately adjusted by means of holes located a short distance apart. The ring or band can be sprung over the pipe, then brought together and held by a bolt. The device shown in Fig. 4 has a split band held together by a bolt at both top and bottom, hence it can be easily put on and removed from a pipe.

Fig. 5 shows a hanger fitted with a band made in one piece which is bolted to a nipple of any desired length. The upper end is threaded and fitted with two nuts, for the purpose of

locking the nipple firmly in place when the desired adjustment is secured.

A hanger with a band made in halves and bolted to a nipple is illustrated in Fig. 6. Another nipple is bolted to the clamps and a turnbuckle connects them as shown. This arrangement provides for an adjustment of several inches, and if the turnbuckle is a good fit on the nipples it will remain in place indefinitely, although the expansion and contraction due to heat and cold, shocks and jars caused by water-hammer in the pipes, and vibration in mills and shops resulting from the use of unbalanced pulleys, sometimes loosen pipe hangers and change the pitch of pipe lines given when they were hung.



FIGS. 1 TO 5.—VARIOUS TYPES OF PIPE HANGERS.

The hanger shown in Fig. 7 has a hinged band that is very convenient. It is bolted to a socket and the clamps above are bolted to another. Between them is a pipe nipple, the length of which decides the "drop" of the hanger. With this exception the hanger is non-adjustable, provided both ends of the nipple are fitted with right-hand threads. Of course, it is possible to unclasp the band and turn the sockets in the required direction to secure the adjustment desired, but this does not really constitute an adjustable hanger in a strict sense of the word. If this is a right-and-left nipple with threads in the sockets to correspond, adjustments could be made at any time with a pipe wrench, as already described in connection with a previous illustration.

Fig. 8 illustrates a hanger fitted with a hinged band that locks around a nipple which carries a nut at either end, although no provision is made for locking the nipple in position. The nipple is made as near the desired length as practical, then final adjustments are made with these nuts. That shown in Fig. 9 carries a ring that is split horizontally, therefore it is easily disengaged from the pipe for adjustment to give proper pitch as follows: Suppose that after this hanger is put into position with the pipe in place, it is too low. The screws which hold the lower half of the ring should be removed, the set screw at the center of the clamp loosened and spread slightly, but not enough to release them from the girder, the upper half of the ring swung clear of the pipe and turned from right to left, or in the direction which tightens a nut that is fitted with a right-hand thread. The upper half of the ring should be dropped into place, the lower half secured in position, the clamps readjusted, and the job is done.

These directions are given in order that those who are not familiar with such work may understand what can be done with these appliances. However, the hanger shown in Fig. 10 is of superior design, although it appears similar to the preceding, for if the pipe is to be raised it is only necessary to turn the nut which appears directly under the clamps until the desired height is secured, which completes the job.

FIGS. 6 TO 10.—VARIOUS TYPES OF PIPE HANGERS.

When a new heating system is to be installed or one that is already in use remodeled, it is a good idea for one to devote the necessary time in careful consideration of what can be accomplished along the line of the pipe hangers rather than to adopt the first plan presented.

# LETTERS ON PRACTICAL SUBJECTS

### SMOOTHING ROUGH COMMUTATORS.

The electrician or engineer often has a badly behaving direct-current motor in the plant that causes trouble by sparking and flashing, rattling of the brushes and heating of the commutator simply because the segments are either rough or burned, or the whole surface is not true. The tendency to spark is greater with a motor exerting its full horse-power than when not working to its limits; and with a constant, heavy load, when the sparking does begin, the commutator suffers from the very start. Black stretches appear on the bars under the path of the brush contacts, while the brushes in turn are worn down extra rapidly by such roughness. A common remedy is the application of coarse and fine glass-paper fitted to a curved block. A daub or two of compound or oil completes the doctoring, but does not improve things much. Glass-paper will smooth the segments somewhat and leave a polish, but will not true the surface, and after a half hour of such treatment the brushes still clatter defiantly for all the commutator shines like new. To remove an armature to be trued in a lathe takes time that often cannot be spared. A truing device is very handy, but even that takes time to get it into operation. A very good remedy that does not take much time has been tried by the writer on many motors. A carborundum stone 7 in. long, 2 in. wide, 1 in. thick, of fine grain, should be procured and an arc cut out of the wide, flat surface at one end to fit or nearly fit the commutator. With the motor running with its usual load the near end of the stone should be held with one hand and with the other hand the cutting pressure on the commutator may be regulated. By moving the stone slowly across the bars it is prevented from cutting new grooves, and at the same time wears down the high bars and ridges evenly and rapidly.

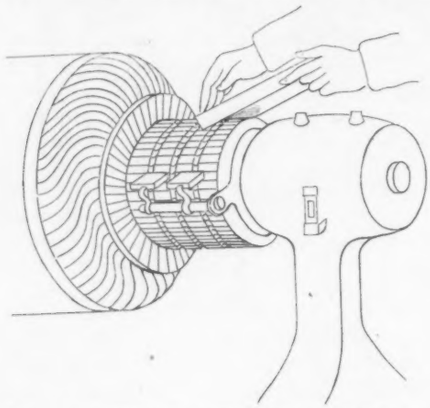


FIG. 1.—SMOOTHING ROUGHENED COMMUTATOR.

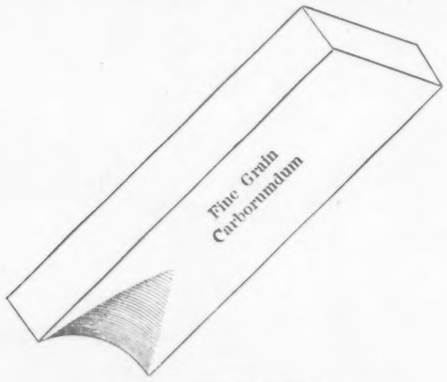



FIG. 2.—TRUING STONE.

Next there should be applied to the surface a piece of clean, dry pumice stone. This should be moved across the bars with a light pressure at first till it receives a curved surface; as the commutator smoothens more pressure may be applied to produce a polish. Most any size commutator can be smoothed and polished without the use of glass-paper, file or truing device and without removing the armature. Of course, turning down in a lathe is the best when time will allow. The writer has applied a fine-grain carborundum stone and dry pumice stone to a score of motors about a large plant many times with excellent results, without truing even one in a lathe. In applying the stone a film of copper will collect on its cutting surface which should be scraped off occasionally. A clean surface of the pumice stone should always be applied to the commutator, and by means of clean waste the dust of cutting and polishing may be frequently removed from the commutator. The surface should first be trued with the carborundum and the pumice used to polish it.

Poughkeepsie, N. Y. H. S. Rich.

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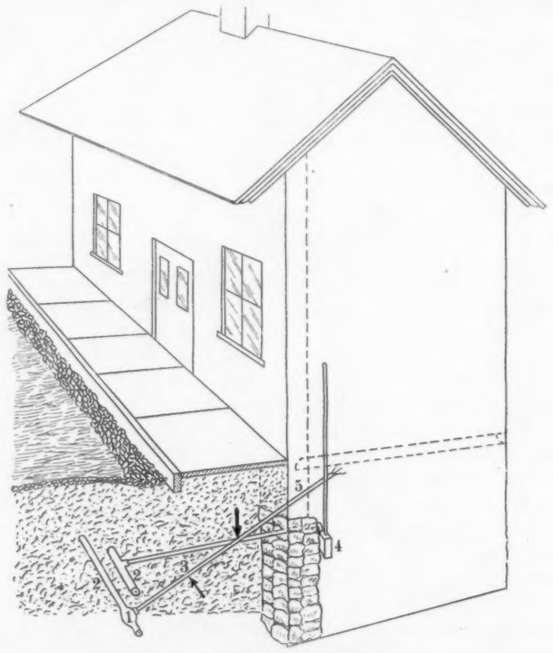
### A HUMMING GROUND.

A very peculiar incident was called to the writer's attention a short time ago, when a householder complained of a violent humming in the vicinity of his gas and electric meters, which had grown to be unbearable. It was at first felt that the humming must be due to the action of the 60-cycle alternating current in the loose laminations of the stator windings of the electric meter, but when the main switch was opened the noise continued as much as ever. When the gas meter was disconnected a fat spark was noticed at both the inlet and outlet of the meter when the latter was taken down, and the noise ceased at once. A voltmeter placed across the inlet and outlet to the gas meter gave a reading of 90 volts and a similar reading was obtained between the inlet and a steam pipe nearby. Upon further investigation an old and abandoned underground electric service was discovered alongside of the gas pipe. Not wishing to place insulating joints on the gas meter, the street was dug up and it was found that the gas and electric service pipes crossed and touched each other just outside the building line. There was a strong smell of gas and the ground was blackened. Evidently the gas main had been made porous by the action of the electricity from the grounded service and at the gas meter a drum effect resulted from the gaseous dielectric enclosed in the casing of the meter. Had the cross



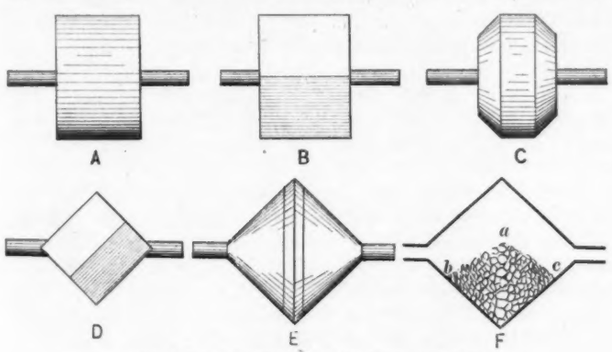
HUMMING GROUND.

been permitted to remain very much longer, a bad gas leak would have probably resulted. In the accompanying engraving the conditions are illustrated. Here 1 is the electric conduit, 2 the gas main, 3 the point where the pipes crossed, 4 the gas meter and 5 the abandoned service. In eliminating the trouble the service conduit was cut at the point where it left the junction box, the gas meter was replaced and when the main switch was again closed no sound was heard and no trouble has been found with the service since.

Newburgh, N. Y. A. P. Broadhead.

### DEFECTIVE CONCRETE MIXING.

When the materials which enter into concrete for engine foundations or for other engineering structures are properly proportioned, there is found to be much less mixing required than when the sizes or grades are improperly proportioned. This applies to the cement proportion as well as to the amount of any size of sand or gravel which may enter into concrete. The proper amounts of each size or grade vary with the diameter




VARIOUS SHAPES OF CONCRETE MIXERS.

of the largest size of material used in the concrete, but no matter what the size of the largest material used, the mixing becomes harder as the proper proportion of sizes is departed from. When the dry concrete mixture is properly proportioned for maximum density the several sizes of material seem to fall into place naturally and with very little effort on the part of the mixer. But let the proportions be departed from to a considerable extent and great trouble is met with in obtaining a thorough mixture, and the material even seems to separate to a considerable extent upon the slightest provocation. Aside from the matter above noted, the writer desires to sound a word of caution to all users of concrete against certain forms of power mixers which are, or may be placed, in the market. The commercial forms of concrete mixers now in use consist of two types: the continuous mixing pug-mill or paddle machine and the cylinder, in which batches of concrete material are revolved until their ingredients are supposed to be thoroughly mixed. The pug-mill has no place as a mixer of dry materials for the reason that the volume in a given section of the machine must travel along in much the same condition as it was in when it entered the machine. That is, if a considerable volume of each grade of material be dropped in succession into the pug-mill the grades will necessarily come through in the same order that they entered the machine. It is impossible, in this machine, to mix a portion of material in one end of the machine with material in the other end. Thus the product of a pug-mill mixer is extremely likely to be made up of a string of differently constituted mixtures.

Undoubtedly the best concrete mixer is a revolving cylinder, the diameter of which is quite large in comparison with its length. To obtain the best results, the length should not be more than one-half the diameter of the cylinder, and the ends should be straight and at right angles to the shaft. Some mixers are made with conical or semi-conical ends. Such shapes are not capable of giving the best results in mixing material of various diameters. It is not necessary that the mixing case or vessel be circular. It may be square or rectangular, but it is essential, as will be hereinafter demonstrated, that the ends of the containing case at all times stand perpendicular to the axis about which the mixer revolves. Thus, a cubical case may be used to advantage, provided that it is so supported that its axis passes through the middle of two sides. But when the rectangular case is supported and revolved upon an axis which passes through diagonally opposite corners, then the device becomes a separator instead of a mixer. The accompanying illustration indicates several types of revolving mixers in common use. *A* represents the plain cylindrical mixer, one of the best forms made; *B* represents a square or rectangular mixer with the heads square with the shaft. A common form of mixer is shown at *C*, the corners of the cylinder having been removed. This is a defective form of mixer, as will be shown later. *D* is another bad form, and a very common one, too. This mixer is rectangular like the one shown at *B*, but it is supported and revolved upon an axis which passes through the corners instead of through the middle of two of the heads. The mixer shown at *D* is an innocent-appearing device and no one would suppose that this machine is more of a separator than a mixer, but such is the case. The coarse particles will go to the middle of the mixer and the finer materials will arrange themselves adjacent to each other according to their size. This seems strange, but it is easily proved as follows: Procure a couple of glass funnels, such as are used by druggists and chemists. Place a quantity of sand and gravel, of assorted sizes, in one of the funnels, then fasten them together, as shown, by means of a bit of adhesive plaster. Next, hold the funnels nearly horizontal and revolve them slowly a number of times. The gravel should roll and tumble across the funnels. After revolving the funnel a couple of dozen times it will be found upon examination that the coarse and fine material is arranged as shown at *F*, the coarse particles being found in the middle at *A*, while the fine particles are arranged on either side, as shown at *b* and *c*. The writer will offer no explanation as to why such a separation of sizes takes place. It is sufficient that the separation does take place. Square-ended concrete mixers should always be used, conical or diagonally mounted mixers avoided, if good results are desired. Above all, a properly proportioned mixture of coarse and fine material should be employed; the coarse or largest size being as large as possible up to 2½ in. in diameter. Then, the above conditions being filled, a fine quality of properly mixed and proportioned concrete will be the result.

Detroit, Mich. James Francis.

### DETERMINING THE POWER REQUIRED.

An engineer who is largely interested in placing electric motors from the standpoint of the salesman, recently remarked during a conversation with the writer that it troubled him more than anything else to ascertain exactly the amount of power demanded by any machine. There was, he stated, no published tables of horse-powers actually consumed by machines of all kinds, although many random machines had been tabulated.

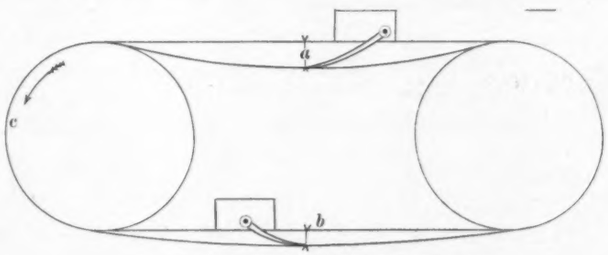



FIG. 1.—MEASURING THE CATENARY SAG.

He further stated that the great difference in the connection and operation of different machines of the same size and kind made tables prepared for certain conditions almost valueless under other and new conditions which were constantly being met with. In view of the above situation, it would be extremely convenient to be possessed of some means whereby the power which is actually being transmitted to a machine by the driving

belt may be measured during the usual working of the machine in question. In the May, 1908, issue the writer presented a letter to the effect that every driving belt was a dynamometer by means of which the power absorbed by any machine could be readily measured. The manner of measuring was to ascertain the drop or sag of the belt on both the driving and driven sides, then from a table of catenary constants and the weight of the belt per linear foot, and the distance apart of the point

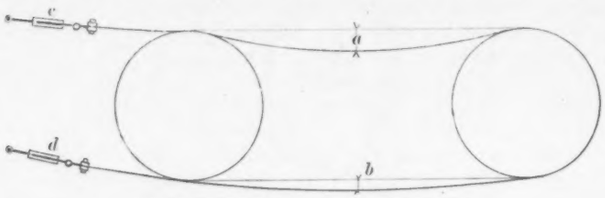



FIG. 2.—DETERMINING THE BELT PULL.

of suspension on each pulley, the exact amount of tension in each fold of the belt could be calculated.

It is evident from the behavior of a belt that the working side hangs at a much flatter catenary than does the idle or return side, and that the exact amount of sag must depend upon the distance apart of the points of support, the power pull and the weight of the belt per foot as above stated. The amount of sag may be readily measured by means of a couple of fingers or pointers which are erected so as just to touch the inside surfaces of each fold of the belt and to indicate in inches the average deflection at the points of the belt which shows the greatest deflection. This being done, either one of two methods may be followed to ascertain the pull on the belt in each fold. Fig. 1 illustrates the sag or catenary determination which merely calls for the locating of two pieces of board or metal upon adequate supports, as shown at *a* and *b*. Flexible-spring fingers are attached to each of these boards, the lower edges of which are located exactly in line with the pulley faces, as shown. While the belt is running, the spring fingers are deflected until they touch the belt while it is in its average running position. There will, of course, be more or less fluctuation to the belt, but the fingers being arranged to drift with the belt, and being very flexible, the average position of each belt-fold can be quite closely marked by the flexible fingers.

It is evident that with the belt at rest the amount of sag in the working and idle folds will be equal, but when the belt is working the deflection of the two folds will be unequal and the average amount of deflection of each fold is found as above described. The next step, after having found the deflection, is to determine the amount of pull on the belt necessary to cause the deflection noticed. To determine this point the belt is opened at *a*, Fig. 1, and clamps are attached to which are made fast the spring balances and turnbuckles *c* and *d*. It may be necessary to block securely the pulley around which the belt passes. The turnbuckles are then screwed up until the belt folds give exactly the amount of deflection noted by the flexible fingers while the belt was running. If there is any trouble experienced in blocking the shaft, the pull measuring may be done by screwing up both turnbuckles until the sag is just right at either *a* or *b*, and after the pull on the belt has been recorded for that sag, the pull on the belt should be changed until the recorded sag for the other fold has been reached, when a reading may be taken on the spring balance through which that strain is passing.

It is possible to do this work with a single balance, which may be shifted from one fold to the other as required. But the erroneous method of determining both belt pulls from the same fold of belt by letting it down to the different deflections in succession should not be tried. The method will not give correct results for the following reason: The length of belt in fold *b* is greater than that in fold *a*, hence there is a considerable difference in tension in the belt, due to this cause alone. To obtain the actual strain, or belt pull, it must be actually weighed under the exact working conditions and this can only be done by weighing the pull of each fold in its proper place on the pulleys.

The other method of ascertaining the belt pull, and one which does not call for opening the belt, is to procure a narrow belt or wire cable of known weight to the foot and place this around the pulleys, as shown by Fig. 2, the working belt having been removed or run to one side a trifle to let the test belt or wire to be put in place. The pull on each fold of the wire is ascertained as before, then a table of constants, or a curve, is consulted which has been prepared for the particular weight of trial wire or belt used, from which table or curve the amounts of pull which would be given by a belt of the weight and length corresponding to the working belt in actual use may be found.

For small belts the first method would be preferable, but for large, wide belts, which would require a spring balance of great capacity, the second method would be better—or a modification of it. For instance, were the engineer to make the pull measurements with a known weight of belt, say, a 3-in. or a 4-in. belt, then a very simple table or chart would be required in order to obtain the actual belt pull from the trial figures obtained by measuring the pull of the belt of given width. The difference in pull, times the belt velocity in feet, divided by 33,000 will give the horse-power transmitted.

Willoughby, Ohio. James F. Hobart

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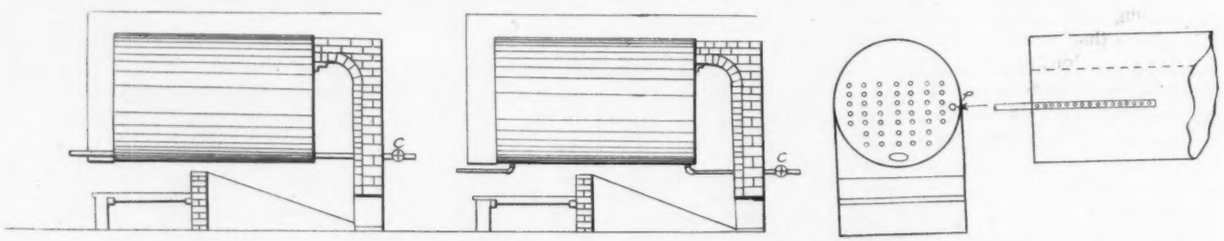
### FEEDING AND BLOWING OFF A HORIZONTAL TUBULAR BOILER.

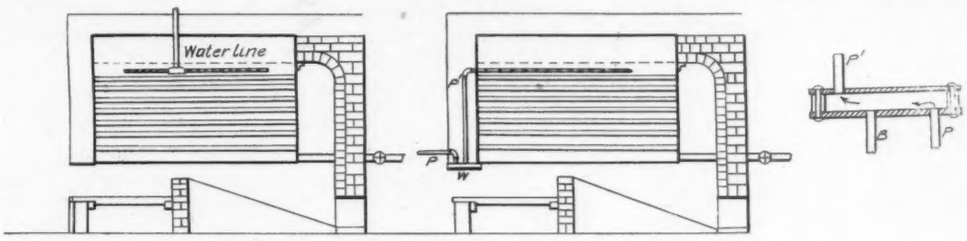
Fig. 1 is an illustration of a horizontal tubular boiler that receives its feed-water through a pipe tapped into the front or rear head. Formerly, the location of the feed pipe was never given any consideration. Any place was good enough so long as the pipefitter or boilermaker succeeded in placing the pipe close to the crown sheet so as to insure a speedy boiling of the water. That was the one idea. There was no thought given to the destructive effects of the cold or partly heated water on the crown sheet; the paramount idea was to get the cold water as close to the fire as possible. Fig. 2 represents what was at one time considered an improvement in the art of boiler feeding. Here the feed pipe was tapped in the shell or



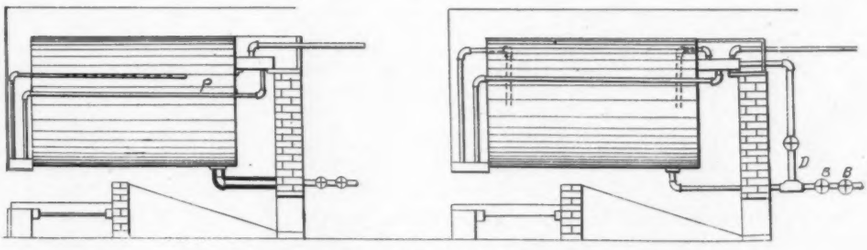
FIGS. 1 TO 4.—METHODS OF FEEDING TUBULAR BOILERS.

crown sheet directly over the fire, and hence the feed-water was closer to the fire than in the previous case; therefore, it was thought a better method was found for feeding boilers. At the present time, no boilermaker of any standing would sanction either of the above methods of feeding water to a horizontal tubular boiler or any other type of boiler. It was found by feeding water close to the crown sheet that the metal in the vicinity of the cold or partly heated feed-water entrance

crystallized and leakage occurred around the feed pipe and shell. The crown sheet cracked, requiring patches and in some cases an entirely new firesheet was necessary; hence it was clear that both methods of boiler feeding mentioned were by no means the best. The first improvement that followed the above methods was to raise the feed-pipe connection and place it some distance up the tube sheet so as to permit the entering feed-water to mingle with the water already within the boiler, which was at a higher temperature. Fig. 3 shows this improvement. Here the feed pipe is tapped into the head or tube sheet about half-way up, as shown at *P*. The specific gravity of the water entering the boiler being a trifle greater than that of the water in the boiler, the entering water settled toward the crown sheet and in doing so mingled with the hotter water, thus lessening its gravity and giving it a tendency to move upward. Hence its impingement on the fire sheet is lessened thereby, increasing the longevity of the crown sheet. By extending the pipe *P* within the boiler and below the water line and allowing the feed water to flow through a series of small holes in the pipe, as shown in Fig. 4, the specific gravity of the feed-water is lessened and a mingling of the water at different temperatures more easily obtained; the feed-water being sprayed over a greater area. Fig. 5 shows the next improvement, which consists in having the feed pipe enter the top of the boiler and extend downward below the water line, teminating in a tee, as shown. The tee is fitted with two nipples that are open at their ends and perforated for their entire length. The portion of the feed pipe extending above the water line and in the steam space is subjected to the heat of the steam and hence the temperature of the feed-water is raised a certain amount before being scattered about or sprayed through the water already in the boiler. Fig. 6 shows the next step forward in supplying the boiler with feed-water. A water arch is substituted for the old-time brick or block arch; the water, after passing through the heater, being discharged into the water arch *W* through the pipe *P*, and after absorbing a certain quantity of heat in traversing the arch the water then enters the boiler through pipe $P^1$. Pipe $P^1$ is located below the water line and extends within the boiler a distance equal to three-fourths of the boiler length; the pipe being open at its end and perforated as in the previous cases. The substitution of the water arch not only elevated the temperature of the feed-water, but it also removed a serious defect in the boiler setting. The front arch, being previously constructed out of fire brick or baked blocks, was rapidly eaten away by the heat, requiring considerable repairs, the bricks falling down and admitting large quantities of cold air over the fire. Fig. 7 is a sectional view of a water arch built up out of boiler iron. The water enters the arch through the pipe *P*, then moves across the arch and out at $P^1$ as shown. The arch is provided with one or more handholes for the purpose of cleaning, and a blow-off pipe is also connected in the arch as shown at *B*. Sometimes the water arch is not constructed of boiler iron, a heavy hollow casting or a series of pipes being used as a substitute. Fig. 8 illustrates the next step forward in the art of boiler feeding. It was found that the rear arch gave almost as much trouble as the front arch by reason of the lengthening and shortening of the boiler when subjected to heat, causing the brickwork to drop down or fall out of position. In order to overcome this difficulty a water arch was substituted for the rear brick arch and hence what is known as the double water arch, single-feed system came into existence. The feed-water from the heater enters the rear arch as indicated and after traversing the arch enters the front arch through pipe *P*. Thence the water flows to the boiler as shown by the piping. Pipe *P* need not occupy the position indicated. In connecting the two arches together it may be run in the upper flue or through the furnace, being raised sufficiently to protect it from injury by the fire tools. This method is preferable to running the pipe through a tube or outside of the wall. The double-arch, double-feed system with circulating pipe connected directly into the blow-off pipe as shown at *D*, is illustrated in Fig. 9. This system needs no further explanation, as it is somewhat similar to that described in Fig. 8, with the exception of the feed connection in the back and the circulating pipe in the blow-off to protect the latter from being burned or filled with scale. The rapid movement of the water through *D* prevents the destruction of the blow-off pipe, hence the blow-off need not be protected with asbestos as shown in Fig. 8. The same connection could be made to the blow-off in Fig. 8 providing the arch was tapped for the extra connection; the expense of making this connection being the only consideration. Referring to Figs. 1 and 2 the old style of connecting the blow-off pipe is shown. The pipe being unprotected its rapid destruction follows, there being no circulation to prevent the blow-off from becoming filled with sediment. The only way to prolong its life is to open the blow-off cock regularly night and morning in order to clean out whatever scale may have accumulated during the night and day run. With this style of blow-off connection, the best time to blow is in the morning before the steam pressure rises over 10 lb. or 15 lb. In some cases where the blow-off pipe is run over the top of the boiler it is necessary to blow with a much higher pressure. At the noon hour and after closing down at night the blow-off should be opened for a short time, at least in order to clear the pipe. The constant opening of the blow-off cock or valve, as shown at *C*, Figs. 1 and 2, insures a rapid destruction of the seat because the sediment, or a portion of it, will rest on the seat, making it necessary to use a wrench to close the valve tight. Sometimes it is impossible to close the valve or cock steam tight, owing to the lodgment of scale around and beneath the valve disk, no matter what size wrench is used; hence, the steam and water rushing through the small opening cuts away the seat and disk, leaving a leaky blow-off cock or valve. The plan adopted and shown at *B B* is best. Here the blow-off pipe is fitted with two cocks or valves.




FIGS. 5, 6 AND 7.—FEED-WATER ARRANGEMENTS AND WATER ARCH.




FIGS. 8 AND 9.—FEED-WATER AND BLOW-OFF CONNECTIONS.

NEW YORK CITY. K. WALTERS.

# QUESTIONS AND ANSWERS

Please inform me whether a 33,000-volt transmission line will in any way interfere with wireless telegraphy? B. F. E.

There is no doubt that a 33,000-volt transmission line would affect to some extent a wireless telegraph station in its immediate neighborhood. However, the interference is doubtless negligible, because no cases of interference have been brought to our attention.

What effect does soda ash have on boiler feed water and what are its disadvantages? A. M.

The effect of soda ash on boiler feed water will depend on the impurities in the water. Ordinarily small quantities of the substance are used to change troublesome sulphate of lime to carbonate of lime which can be easily handled in a feed-water heater. If the use of straight soda ash results in priming and cutting of oil from the cylinders of engines, tannic acid may be introduced to destroy the alkalinity of the water. The objections to its use are that it works the joints of steam lines, causes foaming and saponifies the oil used for lubrication in the cylinders of engines.

What are the standard voltages used in mining operations? W. G.

There are no standard voltages for mining operations. The companies operate under mining laws which differ in the several States and which unfortunately have not kept pace with the application of electricity to mining conditions. In very many mines 250 volts is the highest tension used, while in others the three-wire system with grounded neutral using 550 volts between the outer wires is employed. Foreign mining experts requested to investigate conditions in mines by the U. S. Geological Survey recommend 650 volts, direct current, and 500 volts, alternating current, as limitations for the underground distribution of electricity in mines.

When using choke coils in connection with lightning arresters, where should they be connected? K. F. K.

Choke coils should preferably be placed in the leads from the transformers or generators and inside the switches. While but one set of arresters may be used on an incoming line to which a number of transformers is connected in a bank, a choke coil should be placed in the leads of each transformer. Ordinarily choke coils are used so that there is one arrester and one choke coil on each wire of an incoming line. It has been suggested that for the protection of generators of a certain voltage, choke coils of the next higher voltage rating be employed, since these have an increased number of turns and give a higher protection to the generator.

A 7½-hp, 220-volt, 25-cycle, induction motor is run on 40 cycles. The machine is continually hunting and sometimes stops. The rotor is of the squirrel-cage type and becomes quite hot when running under normal load. The bolts holding the conductor bars to the end rings are all good and tight, so that there is no trouble there. The speed of the motor also drops when the load is thrown on. The motor has four poles and 60 coils and runs on two-phase current. The thing which is puzzling is that only the rotor becomes hot. Could the change of frequency have anything to do with the hunting and heating, or is the trouble due to the construction of the machine? C. F. K.

When an induction motor normally designed for operation at 25 cycles is run at 40 cycles it is subjected to considerable increase in speed, and probably mechanical difficulties will be encountered on account of the increased speed. However, the machine should be able to carry full normal power load, although it could not ordinarily be subjected to as great torque as one operated under normal conditions. Hunting is almost unknown in the operation of induction motors. Whenever it does occur it can be attributed to some condition external to the motor itself. If the load fluctuates violently the machine is liable to hunt, moreover, if the generator speed is not constant the machine may seem to hunt. If the rotor winding of your squirrel-cage induction motor becomes warm during operation then it is evident that the machine is subjected to conditions quite different from those for which it was designed, independent entirely of the fact that the frequency has been changed from 25 cycles to 40 cycles.

If the neutral of the primary of a Y- to Y-connected bank of transformers be grounded, does this tend to increase the electrical insulation stress between the high- and low-tension windings? Would it protect a delta-connected generator in case of a breakdown between the two windings? Kindly explain the following: In a star to delta system, if one leg of the delta is opened and short-circuited, the voltage of the transformers is increased 73 per cent, while the line voltage is increased 300 per cent. G. M.

The grounding of the neutral of a system has no effect upon the insulating stresses to which it is subjected under normal operation. Under normal conditions, the mechanical neutral point of a system tends to remain at the ground potential; however, if one of the wires becomes grounded the mechanical neutral point is shifted by 57.7 per cent of the delta voltage. It may safely be said that the insulating stresses will be reduced rather than increased when the neutral of the system is grounded. An answer to your other question is given in detail in the article by Mr. W. T. Ryan, which appeared in the December, 1908, number.

Can good regulation be obtained over a transmission line two miles long made of No. 4 copper wire and carrying 60 kw at either 125 or 133 cycles, single-phase, the voltage being 2200? What I desire to know is whether four miles of No. 4 copper wire will offer enough resistance to the 27 amp, at the above voltage and frequency, to cause surging in the line and thus make the voltage fluctuate so much that it would not be suitable for lighting purposes. W. H. G.

The resistance of No. 4 wire is about 0.25 ohm per 1000 ft., so that a transmission line two miles long would have a total resistance of somewhat over 5 ohm. A load of 60 kw at an e.m.f. of 2200 volts would require 27.3 amp. The loss in a 5-ohm line would be about 3.7 kw, or, roughly, 6 per cent. The reactance at from 125 cycles to 133 cycles would probably be about 8 per cent; the impedance, 10 per cent, and the voltage regulation at full load would probably be about 7 per cent. A regulation of this value should prove satisfactory, provided the equipment will permit of increasing the e.m.f. at the station, with an increase in load on the system. It might be well also for you to read the article appearing on page 36 of the January number in this connection.

We are operating a 133-cycle system, and it is proposed to change over to 60 cycles. Will it be practicable to operate the same transformers on 60 cycles? What effect will the change in frequency have on the voltage ratio of the transformers or on their performance? P. H. H.

The ratio of the primary and the secondary voltage of a transformer is in no wise affected by a change in the frequency. The ratio depends solely upon the number of turns. If, for example, there are 10 times as many turns in the primary coil as in the secondary coil, then the ratio of transformation is 10 to 1. When the frequency is changed, say, from 133 cycles to 60 cycles, the transformers can be operated at the original voltage with an increase in the iron loss, or they can be operated at a reduced voltage at the former value of iron loss. When a 133-cycle transformer is operated at 60 cycles it will be subjected to the original iron loss if the voltage is reduced to about 75 per cent of its former value; if, however, the voltage is given the same value as before the iron loss will be increased by about 60 per cent. The total losses in a transformer would be increased somewhat less than 30 per cent, and the temperature rise would be increased by slightly less than 30 per cent. It might be well for us to mention in this connection that it has been the practice of several of the manufacturing companies to build their transformers for operation at either 133 cycles or 60 cycles. The transformers are really 60-cycle units, and when operated at 133 cycles they are subjected to slightly decreased loss and decreased temperature rise.

# CENTRAL STATION

## MANAGEMENT, POLICIES AND COMMERCIAL METHODS

## The Electric Vehicle Situation in Boston.

Within the past two months organized efforts to develop the use of electric vehicles on a larger scale than ever before have been vigorously pushed in Boston. Through the co-operation of the manufacturers and central-station interests active steps are being taken to popularize the electric vehicle for both commercial and pleasure service. On Feb. 25 a meeting was held at the Boston Athletic Association clubhouse at the call of General Superintendent W. H. Atkins, of the Edison Electric Illuminating Company of Boston, for the purpose of securing the co-operation of manufacturers, manufacturers' agents and representatives of the Edison company in the furtherance of electric automobile work. Mr. Frank J. Stone, New England manager of the Electric Storage Battery Company, who presided, discussed the possibilities of the electric vehicle in this territory, showing the accessibility of many natural advantages to the electric automobile through good roads and emphasizing the importance of suitable garage accommodations and an active interest in this business on the part of the central stations. The sphere of usefulness of the electric machine was fully discussed, and a committee was appointed to report plans for organization.

On March 11, at the Hotel Tuilleries, during the week of the Boston Automobile Show, about 50 gentlemen prominently interested in central-station and automobile matters met as a result of the previous work of the committee and, after a banquet, voted to form an organization to be known as the Electric Vehicle and Central-Station Association, to develop the possibilities of this field. Mr. Frank J. Stone was elected president of the new organization; Mr. L. R. Wallis, of the Boston Edison company, treasurer, and Mr. H. T. Sands, of the Malden Electric Company, secretary. Discussing the scope of the new association President Stone emphasized the value of this business to all interests concerned and showed that the annual energy consumption of the motor vehicle, ranging from 3600 kw-hours to 10,000 kw-hours per vehicle, is the kind of load which the central station can utilize to the utmost advantage. Mr. Stone said that all auxiliary interests are now in a better position that ever before to co-operate in developing this business. Improved facilities at garages are necessary, proper inspection and care need to be secured for vehicles in service; and public interest can be stimulated in the electric vehicle field. The first number of a monthly magazine devoted to this special work appeared last month as the organ of the association, called *The Electric Vehicle and Central Station*, published at 12 Pearl Street, Boston. Mr. Stone pointed out the usefulness of such a means of publicity, and following his address a paper was read by Mr. William P. Kennedy, consulting engineer, New York, on "The Present Status of the Electric Vehicle." He touched upon the importance of good engineering in the proper application of motor vehicles, and the resulting economies. Lack of skilled analysis has caused much difficulty in the past in situations where the purchaser has not secured the best results.

Mr. W. H. Atkins, general superintendent of the Boston Edison company, then emphasized the company's desire to co-operate with others in encouraging the use of the electric pleasure and commercial vehicles.

On March 19 Mr. Alexander Churchward, chief of the electrical vehicle motor department of the General Electric Company, at the Edison auditorium, Boston, spoke on "The Evolution and Possibilities of the Electric Vehicle for Commercial, Professional and Other Uses" during a regular meeting of the association. Mr. Churchward reviewed the development of the electric vehicle, presented characteristic curves of the automobile motor, and discussed the whole subject from the technical point of view.

On April 7, Mr. Day Baker, Boston manager of the General Vehicle Company, Long Island City, N. Y., gave a paper before the association on "The Practical Application of the Electric Vehicle." This paper showed in a most interesting way how the congestion in the streets of Boston can be reduced if the possibilities of the electric vehicle are utilized.

At present there is no doubt that the electric vehicle business in Boston is only a small part of the total automobile business, and many of the garage men have felt that there is little money in handling electric motor cars compared with the profits of the gasoline car in the garage. This is not the case in all the garages, but it is a fact that the profits on gasoline car repair work are often so high as to turn the interest of the garage manager away from the electric machine. There are at present between 150 and 200 commercial and pleasure electric vehicles in Greater Boston. The number is less than it would have been had it not been for the recent fire at the Park Square Garage, where several valuable electric, as well as many gasoline, machines were totally ruined. While the garage situation is somewhat unsatisfactory at the present writing, the movement under foot by the association is rapidly improving conditions. Among the principal garages which handle electric vehicles the following rates are representative:

Rate for charging transient cars, 10 cents per kw-hour; minimum charge, 50 cents.

Rate for doctor's runabout, always ready, including oiling and inspection, but not repairs, charging, 10 cents per kw-hour.

Monthly rate, charging small runabouts, excluding inspection, $15; including inspection and oiling, $18 to $20.

Garage storage charge, per month, $20.

Total rate on 1000-lb. delivery wagon, including storage, washing, polishing, inspection, oiling, minor repairs and charging, per month, $40.

Total rate as above on pleasure vehicles, $30 to $35.

There are a number of private garages now in Boston which utilize the mercury-arc rectifier to advantage on the regular motor rates of the Edison company, which bring the charging rate to from 12 cents to 6 cents or 7 cents per kw-hour according to the amount of energy demanded. These rates in a garage charging continuously a considerable number of machines will easily be cut in half, or reduced still lower.

It is expected that within three weeks a garage for the exclusive use of electric vehicles will be opened by Mr. N. Rommelfanger on Columbus Avenue. In the conduct of this garage a specialty will be made of the care of batteries, the employees will call for batteries and deliver them throughout a wide territory, suitably charged, and if desired, renovated. A considerable charging business of this character is now being carried on by Mr. Rommelfanger in rather limited quarters. The opening of this all-electric garage will doubtless be a decided stimulation to the electric automobile situation, as there is no establishment of the kind in New England at the present time. The Edison company at present has charging facilities at the following suburban points: Dedham, Natick, Somerville, East Boston, Woburn and South Framingham. The business is purely transient and the rate is 12 cents per kw-hour, with a minimum charge of 50 cents.

The Edison company at present has four electric vehicles, each of 1000-lb. rating. Two are delivery wagons for meters and lamps, one is an emergency repair wagon for underground work principally, and one is a pump wagon. Another 1000-lb. lamp wagon has just been purchased, and also a 3.5-ton construction wagon, motor driven, which will carry poles 26 ft. long. A special agent has been detailed in the sales department to give all of his time to the electric vehicle business, and the

company is making out accurate lists of the electric automobiles now in service, encouraging prospective users and purchasers, listing location of charging facilities and expanding the field that can be developed in commercial and pleasure-car service.

A recent exhibit of a Studebaker machine for pleasure service, with the estimates of its cost, in the exhibition department window of the company was described lately in this paper. A complete six-months' record of the cost of operation and service of this machine is given herewith through the courtesy of Mr. S. G. Thompson, of the Boston branch of the Studebaker company.

During the six months the vehicle traveled 3437 miles on 91 charges, making an average of 37.77 miles per charge of the battery. The total cost of energy for charging, at 7.5 cents per kw-hour, was $51.16. The mechanical repairs cost $10.16, the battery repairs $6 and tire repairs $42, making the total cost of operation $109.32. Painting cost $21.40, so that the total gross expense was $130.72. The average gross expense was 71.82 cents per day, or 3.8 cents per mile. Mr. Thompson obtained occasional daily runs of approximately 60 miles per charge with this machine under the most favorable conditions. At the present time this company is making active campaigns for commercial business on a large scale in connection with the larger Boston mercantile establishments, and a large number of pleasure vehicles of this type have been sold within the past few months.

In a recent interview, Mr. Hayden Eames, Boston manager of the Studebaker company, emphasized the great advantages of the electric vehicle for city service, pointing out the unsuitability of the gasoline car for congested streets. He pointed out that to drive a car weighing from 1.5 to 2 tons through crowded streets, stopping, starting, slacking pace and accelerating, to weave a way through the traffic, shifting gears once or twice in every block length, is to subject brakes and tires to severe stresses and it shows up in the annual repair bills in an appalling way. Unless the chauffeur is unusually careful the car will deteriorate 50 per cent in a year under such service. In such a case the electric car will pay for itself in the saving it effects in the depreciation of a heavy touring car. The greater flexibility of control of the electric car, its improved acceleration, cleanliness, absence of cranking, faster effective speed in the crowded streets, shorter wheel-base and simplicity of control all tend to make it pre-eminent for urban work. Through the installation of the mercury-arc rectifier the amount of energy used in charging has been reduced by 40 per cent compared with charging through a rheostat, and this device in the automatic style will enable a car to be maintained in a private garage at a cost of from $7 to $10 per month, including maintenance, renewal of batteries and cost of the charging energy. A considerable number of users of pleasure vehicles in the Boston suburban cities are now handling their own charging through the rectifier with the maximum of ease. Some of these are elderly ladies, who find the electric machine exactly adapted to their needs.

Among the larger garages which handle electric vehicles in Boston are the Motor Mart, on Park Square; N. Rommelfanger, Motor Mart; the White Garage, Newbury Street; the Dodge Motor Vehicle Company, maintaining over 125 electric cars; the Massachusetts Automobile Club (private, for members); Regent Garage, Hotel Beaconsfield, Brookline; Central Garage, Brookline; Chestnut Hill and Newton garages, with other charging points in the suburban territory. This phase of the business is still comparatively undeveloped in Boston, but with increasing use of the vehicles much more extensive and complete facilities will be offered.

Prominent recent purchasers of electric automobiles in Boston show the variety of uses to which these machines may be put. The National Shawmut Bank, the largest in New England, has a 1-ton special wagon for the carting of bullion and making of collections, delivery of payrolls, etc. This machine superseded three shifts of horses. The Paine Furniture Company has a 2-ton electric truck of General Vehicle manufacture which took the place of two two-horse furniture vans for suburban deliveries within the 15-mile radius of the city. The Boston office of the General Electric Company recently purchased a 2-ton truck, for delivery purposes, of General Vehicle make. The Walter Baker Chocolate Company has a large electric truck in use in its factory-yard and city-trip service, and there are several electric sight-seeing wagons in use in Boston. Several dry-goods firms are becoming interested in the electric delivery wagon, and the manufacturing companies are taking up the matter from the engineering point of view with the intention of specifying the equipment which will produce the best service for a given initial expenditure and maintenance cost.

Summing up the Boston situation, it is evident that the city is becoming thoroughly awakened to the importance and advantages of the electric vehicle. The formation of the new association and the establishment of the magazine are stirring up interest. In the co-operation of the various organizations concerned, with care to avoid the pitfalls of the past, there appears an assured and profitable expansion of motor-vehicle service in the New England capital.

## Building Up a Decrepit Central Station.

What can be done toward rejuvenating a decrepit central-station plant is illustrated by the case of a small installation in Herrin, an Illinois coal-mining town of 7500 inhabitants. The plant having passed into the hands of a receiver, the management was changed and the methods modernized. The tungsten lamp was introduced and notwithstanding the lower consumption of electrical energy, the bills of almost all customers have increased through the use of more light, and complaints have greatly decreased. Last season 50 fans and 14 electric irons were sold, and there are present prospects for 25 fans and 100 irons. In 12 months the load of the station has increased 20 per cent and the income 50 per cent. A new 150-hp boiler has just been installed and another generating unit is under consideration. Preparations are being made to ground all secondaries. The matter of a power load has just been taken up and one motor already sold. Mr. Fred. W. Richard is president and general manager of the plant, and it is through his efforts that the success thus far achieved is due.

## Meter-Reading and Billing Methods.

The discussion at the Missouri Electric Light Convention, April 17, brought out some points worth considering in connection with meter reading and the billing of consumers from the meter books. There was a strong sentiment among some of the members in favor of the plan of arranging consumers' ledgers in the same order as the meter-readers' books, these meter-book leaves being arranged by routes for the convenience of the meter readers. This arrangement of consumers' loose-leaf ledger accounts in the same order as the meter-readers' route books makes it possible to transfer a meter reading to the consumer's ledger with minimum loss of time in turning ledger leaves and with minimum possibility for mistakes or omissions. Practically the only argument that can be advanced against this method is that the company may not be using a loose-leaf consumers' ledger which permits of arranging consumers' accounts in any order desired. This is not a difficult matter to change. Of course, if the consumers' ledger accounts are kept in the order of the meter-reader's route, they must be indexed alphabetically so that an account can be quickly found. Referring to an index in this way, however, takes but little time, so that there is no doubt a net gain in time in the whole operation of billing and crediting by virtue of the time saved in billing. In a small company the bookkeeper will be so well acquainted with the routes that he will seldom refer to the index.

One company reported using a meter-reader's book in which there is a coupon for each month. This coupon is removed

after the readings have been made each month so that the meter reader does not know what the previous month's reading was. This removes the temptation from the meter reader of guessing at a consumer's probable monthly consumption, and so not reading the meter at all. It is probable that sham work of this kind by the meter readers, together with mistakes in reading meters, is responsible for more complaints in large cities than central-station men have any idea of. It is guesswork of this kind that causes a consumer to be billed for as much when he has been away from home most of the month as when at home, and gives rise to well-founded suspicion as to the accuracy of a company's meters and methods.

## Flat Rates Again.

The Missouri Electric Light Convention brought out arguments and reports as to experiments with flat rates which show that the use of flat rates by electric lighting companies is, under present conditions, not by any means likely to become as obsolete as appeared a few years ago. While it is true that there are many small companies serving a large majority of their customers on a flat-rate basis, nearly all progressive and well-managed companies have in the past 15 years got as far away from flat-rate practice as possible. Many have recollections of the size of the coal bill in flat-rate days and the sudden increase in net earnings brought about by the installation of meters. Nevertheless there are some things about flat rates in the present condition of the central-station industry which have set managers to thinking. For example, it was brought out by Mr. C. W. Hough, of Joplin, Mo., at the convention referred to that a certain central station operating under a flat-rate system of charging entirely was earning three times the gross revenue per kilowatt of station capacity that its up-to-date neighbors were enjoying. Now the investment in a central station being proportional to the capacity, any scheme which brings about high earnings per unit of capacity is worth serious consideration for the reason that fixed charges on investment ordinarily form so large a proportion of the cost of serving consumers. The average cost of fuel per kw-hour in the central stations of the country has been going down steadily for a number of years, and this fact in itself changes the situation as regards desirability of flat rates.

In favor of flat rates it is contended that about the only item of cost that is greatly influenced by the waste of electricity which inevitably follows the use of that system of charging is the item of fuel; and that if it is possible with flat rates to considerably increase the revenue per kilowatt of station capacity, the company with low fuel costs per kw-hour can afford to supply electricity for considerable wasteful use, rather than reduce its gross revenue by the use of meters. If fuel costs per kw-hour are very high, as is frequently the case with very small plants, waste of electricity is a much more serious item. It is unquestionable that hundreds of central stations have increased net revenues by the use of meters, which have stopped the waste of electricity and so reduced fuel bills. In some cases gross revenue has probably been increased by the installation of meters, and in other cases decreased, depending very much on the flat rates formerly in use. The greatest loss in flat-rate lighting has usually been in residences where the flat rates were inadequate to cover the use and misuse of the service.

Another aspect of the flat-rate problem brought forward is that the cost of electric service to the consumer usually has to be higher than with meters in order to cover the production of a large amount of electricity which is wasted. This in itself tends to restrict the number of consumers so that the number connected per mile of street is likely to be much less in a flat-rate system than with meters. On the other hand, there are some consumers to whom a flat rate appeals more than a meter basis of charging. Many of these will pay a larger amount per year on a flat-rate contract than if placed on a meter basis. This fact, together with the gradually lowering fuel cost per kw-hour due to the use of more economical machinery and increasing development of water-power, will, it is believed by many, keep flat rates a live issue for many years. At the same time, if the company is desirous of obtaining the largest number of consumers per mile of main, it will have to be in a position to offer meter rates to those who wish to obtain the benefits of their own care and economy in the use of electricity.

It also appears from the Missouri discussion referred to that the much talked-of, but little tried, flat-rate cottage lighting with tungsten lamps is being given a trial. The rate charged is about 1 cent per watt connected per month, with the understanding that the consumer uses nothing but tungsten lamps. As long as the tungsten lamp remains high enough in price to induce consumers to save lamp renewals by turning off lamps when not needed, the plan should work very well if there is frequent inspection of consumers' installations to see that carbon lamps are not being substituted. The plan is at least valuable in getting electric light into cottages where people have been afraid of meter bills. Where installed under these conditions it is not likely to be taken out, even though the meter should be installed later as tungsten lamps become cheaper.

## Mutual Insurance by Central-Station Companies.

At the convention of the Missouri Electric, Gas, Street Railway and Water Association, on April 15, Mr. C. W. Hough, manager of the central-station properties in and near Joplin, outlined a plan of mutual insurance by central-station companies upon which it is proposed to issue policies as soon as $1,000,000 is subscribed. Insurance to the amount of $400,000 has already been pledged. In his paper, Mr. Hough referred to the interest taken in central-station insurance by national and State associations. He gave the amount spent on premiums by traction and lighting companies in the United States as $2,974,000 per year for fire insurance.

It is proposed to form an electric insurance exchange similar to the ice manufacturers' insurance exchange in which members of the exchange pay their pro-rata cost of paying fire losses of members. The plan as carried out in the Ice Manufacturers' Exchange is for each company at the start to pay in an amount equal to the regular premium of the old-line companies on the same amount of insurance. Twenty-five per cent of the amount of the premium is to go for the running expenses of the exchange. Of the amount left after paying running expenses and fire losses of members, one-half is returned directly in cash to the members each year, the other half being kept as a reserve. As the reserve increases, the premiums can be lowered. It is proposed to have the management of the exchange in the hands of the advisory board, consisting of well-known representative men in the business from each State. The attorneys of this board which carry on the work of the exchange will be bonded to the advisory board. Policies at first are to be limited to $10,000 on one risk. As showing the amount of profit in the insurance business as carried on by the old-line companies, an investigation carried on by Mr. Davies, of the American Street & Interurban Railway Accountants' Association, showed that among the traction companies of America about $6,000,000 had been paid in by those companies which had made reports to Mr. Davies. Of this, $4,376,000 went for profit and running expenses. The balance was paid in insurance losses.

In the discussion of Mr. Hough's paper, Mr. W. B. Hays, of Poplar Bluff, said that his company's membership in the ice manufacturers' insurance exchange had saved about 42 per cent in insurance. Mr. Hough said that a company might count on saving from 40 to 50 per cent in the cost of insurance. Mr. R. J. Irvine, of the Marshall Light, Heat & Power Company, which is owned and controlled by the National Light, Heat & Power Company, said that on account of the unwarranted cost of fire insurance this company had cancelled insurance policies on its 31 properties and was carrying its own insurance. Mr. R. B. Boyce, of Charleston, testified to the saving in insurance effected by the ice manufacturers' exchange.

## Central-Station Facts and Factors from Iowa.

The accompanying table, which gives some central-station facts and factors collected from 26 Iowa central stations, was presented by Mr. Austin Burt, of Waterloo, Ia., at the convention of the Iowa Electrical Association, at Cedar Rapids, April 21 and 22. Mr. Burt has for some years been on the "Facts and Factors" committee of this association and this is the first extended report from Iowa central stations which he has presented. In offering these data Mr. Burt stated that the form of report used was one suggested by Mr. J. R. Cravath in the *Electrical World*, and recently used by him in a paper for the presentation of central-station data.

The table divides the central stations reporting into groups. The averages for each of these groups are given and also the grand average of all the stations reporting. The conditions indicated by the table are probably much better than would be revealed by a report covering all of the stations in the State, for the reason that those companies which have taken enough interest in the matter to report to the committee are aggressive enough to have worked up the business to a much more satisfactory condition than the general run of companies through the State. Some of the items in the table, Mr. Burt suggested, this line, and to judge from these data, as compared with the present table from Iowa, some of the Iowa stations reporting must have misunderstood some of the items and counted only the power stations in the items of "investment per kilowatt station capacity" and "station capacity per employee," thus giving as a result abnormally low investment and abnormally high station capacity per employee as compared with the other stations which included the total investment and the total number of employees.

| STATION | Total Population | Station Capacity | Investment per Kilowatt Station Capacity | Gross Annual Income per Kilowatt Station Capacity | Gross Annual Income per $100.00 Invested | Ratio of Expense to Gross Income | Operating Expense per $100.00 Invested | Annual Income per Consumer | Total Connected Load per Kilowatt of Station Capacity | Lamp Load per Kilowatt of Station Capacity | Motor Load per Kilowatt of Station Capacity | Heating and Miscl. Load per Kilowatt of Station Capacity | Ratio Transformers to Station Capacity | Station Capacity per Employee | Yearly Load Factor | Income per Capita | Investment per Capita | Station Capacity per Capita | Number of Consumers per 100 of Population |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | K.W. | $ | $ | $ | % | $ | $ | K.W. | K.W. | K.W. | K.W. | K.W. | K.W. | % | $ | $ | Watts | |
| A | 1,100 | 45 | 244 | 81 | 33 | 80 | 26 | 26 | .7 | .7 | .0 | .0 | 1.2 | 23 | 32 | 3.30 | 10 | 41 | 12 |
| B | 1,200 | 50 | 370 | 93 | 25 | 75 | 19 | 39 | 2.5 | 2.4 | .1 | .0 | .... | 25 | 22 | 3.90 | 15 | 42 | 10 |
| C | 1,400 | 48 | 250 | 114 | 45 | 65 | 30 | 43 | .... | .... | .... | .... | .... | 24 | 46 | 3.90 | 9 | 29 | 9 |
| D | 1,500 | 100 | 200 | 90 | 45 | 72 | 33 | 67 | 1.8 | 1.5 | .2 | .1 | .... | 25 | 21 | 6.00 | 13 | 67 | 9 |
| E | 1,500 | 60 | 192 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1.0 | 29 | .... | .... | 8 | 40 | 7 |
| F | 1,500 | 60 | 200 | 88 | 44 | 76 | 33 | 29 | 1.5 | 1.3 | .2 | .... | .... | 30 | .... | 3.50 | 8 | 40 | 12 |
| G | 1,800 | 75 | 300 | 103 | 34 | 83 | 28 | 42 | .6 | .6 | .0 | .... | .1 | 19 | 50 | 4.30 | 13 | 42 | 10 |
| H | 2,000 | 120 | 208 | 70 | 34 | 36 | 12 | 37 | 1.7 | 1.7 | .0 | .... | 1.7 | 40 | 47 | 4.20 | 13 | 60 | 11 |
| I | 2,000 | 53 | 260 | 111 | 43 | 81 | 34 | 27 | 1.1 | 1.1 | .0 | .... | 1.1 | 27 | .... | 2.90 | 7 | 27 | 11 |
| J | 2,000 | 60 | 133 | .... | .... | 64 | .... | 25 | .8 | .8 | .0 | .... | .... | 30 | .... | .... | 4 | 30 | .... |
| Average | 1,600 | 67 | 236 | 94 | 38 | 70 | 27 | 37 | 1.07 | 1.01 | .06 | .01 | 1.0 | 27 | 36 | 4.06 | 10 | 42 | 10 |
| K | 2,200 | 75 | 292 | 137 | 47 | 62 | 29 | 40 | 2.8 | 2.3 | .4 | .1 | .7 | 37 | 91 | 4.00 | 10 | 34 | 12 |
| L | 2,500 | 80 | 187 | 69 | 37 | 73 | 26 | 40 | 1.3 | 1.3 | .0 | .... | .... | 40 | 45 | 2.20 | 6 | 32 | 6 |
| M | 2,500 | 130 | 138 | .... | .... | 72 | .... | 44 | 2.1 | 2.1 | .0 | .0 | .... | .... | .... | .... | 7 | 52 | .... |
| N | 2,700 | 110 | 218 | 94 | 43 | 79 | 34 | 36 | 2.5 | 1.6 | .5 | .4 | 1.2 | 37 | 24 | 3.80 | 9 | 41 | 11 |
| O | 2,800 | 135 | 200 | 67 | 32 | 72 | 23 | 38 | 2.7 | 2.2 | .0 | .5 | .9 | 34 | 24 | 3.20 | 9 | 48 | 12 |
| P | 3,000 | 175 | 200 | 101 | 51 | 53 | 27 | 65 | 1.3 | 1.3 | .0 | .0 | 1.2 | 29 | 23 | 5.90 | 11 | 58 | 9 |
| Q | 3,000 | 150 | 167 | 67 | 40 | .... | .... | 33 | 1.2 | 1.2 | .0 | .0 | D.C. | 50 | .... | 3.30 | 8 | 50 | 10 |
| R | 3,000 | 120 | 367 | 132 | 36 | 32 | 12 | 50 | 2.9 | 1.8 | .8 | .3 | 1.3 | 40 | 25 | 5.30 | 15 | 40 | 10 |
| Average | 2,470 | 122 | 221 | 95 | 41 | 63 | 25 | 43 | 2.1 | 1.7 | .6 | .2 | 1.06 | 38 | 39 | 4.04 | 9.4 | 44 | 10 |
| S | 4,000 | 250 | 126 | 106 | 85 | 43 | 37 | 59 | 2.2 | 1.2 | .9 | .1 | 1.2 | 42 | 23 | 6.70 | 8 | 63 | 11 |
| T | 5,000 | 255 | 216 | 71 | 33 | 67 | 22 | 33 | 1.9 | 1.4 | .3 | .2 | 1.8 | 32 | 15 | 3.60 | 11 | 51 | 11 |
| U | 8,000 | 300 | 266 | 78 | 29 | 59 | 17 | 33 | 1.9 | 1.6 | .3 | .... | .... | 38 | 21 | 3.00 | 10 | 38 | 9 |
| Average | 5,670 | 285 | 202 | 85 | 49 | 56 | 25 | 42 | 2.0 | 1.4 | .5 | .2 | 1.5 | 37 | 20 | 4.40 | 10 | 51 | 10 |
| V | 15,000 | 900 | 139 | 75 | 54 | 53 | 29 | 63 | 1.9 | 1.4 | .5 | .... | .8 | 50 | 16 | 4.50 | 8 | 60 | 7 |
| W | 16,000 | 650 | .... | 46 | .... | 90 | .... | 57 | 1.1 | .7 | .4 | .1 | .8 | 93 | 29 | 1.90 | .... | 41 | 3 |
| Average | 15,500 | 775 | 139 | 60 | 54 | 71 | 29 | 60 | 1.5 | 1.1 | .5 | .1 | .8 | 71 | 22 | 3.20 | 8 | 50 | 5 |
| X | 28,000 | 2,100 | 190 | 58 | 30 | 42 | 15 | 56 | 1.6 | .9 | .6 | .1 | .8 | 233 | 30 | 4.30 | 14 | 75 | 8 |
| Y | 46,000 | 1,000 | 200 | 109 | 55 | 57 | 31 | 85 | 2.9 | 1.7 | 1.0 | .2 | 1.2 | 125 | 17 | 2.30 | 4 | 22 | 3 |
| Z | 85,000 | 3,250 | .... | 99 | .... | 54 | .... | 97 | 2.8 | 1.6 | 1.1 | .1 | .4 | 427 | 24 | 3.80 | .... | 41 | 4 |
| Average | 53,000 | 2,110 | 195 | 88 | 42 | 51 | 23 | 79 | 2.4 | 1.4 | .9 | .1 | .8 | 262 | 24 | 3.50 | 9 | 46 | 5 |
| Grand Av'ge | 9,411 | 401 | 220 | 900 | 45 | 65 | 47 | 46 | 1.8 | 1.4 | .3 | .1 | .1 | 6.3 | 3.2 | 3.93 | 9.0 | 4.4 | 9 |

were so far from the averages as to lead to some question as to whether proper methods were used in computing by the reporting companies.

In commenting upon this table in the discussion Mr. J. R. Cravath said that, contrary to the indications in the table, the investment per kilowatt station capacity for the larger companies is usually considerably larger than that for smaller companies. Mr. Burt explained that this low average for the larger companies in this table might be due to the small number which reported. Mr. L. D. Mathes said that the high ratio of investment to gross annual earnings indicated that operating a small central station in Iowa is not such a bonanza as some people seemed to believe.

The *Electrical World* has compiled considerable data along

## Data for Rate Making.

Mr. C. W. Hough, of Joplin, Mo., presented a paper before the Missouri Electric, Gas, Street Railway and Water Association, at Springfield, Mo., April 16, on "Equitable Rate Making" in which he showed the method of arriving at the Doherty readiness-to-serve system of rates. He took for a basis some interesting figures which he derived from the United States central-station census figures of 1902.

Mr. Hough said that before deciding on a rate schedule for any central station, the cost should be carefully analyzed. The theory is that each customer should pay his proportion of expense and profits for the service rendered. The total cost to the consumer is not a simple item, but can be divided approximately into four parts, represented by a consumer's charge, a capacity charge, an output charge and profit.

Mr. Hough took as a basis of income and expense the statistics given by the last United States census report on the electrical industry. An analysis of the income and expense of all the purely electric private stations in the United States showed that of the gross income the total expense was 80 per cent and the surplus 20 per cent. The expense, which is 80 per cent of the gross income, is divided as shown on page 1105.

These items should now be distributed as correctly as possible into three items, consumer's charge, capacity charge and output charge. The consumer's charge should cover cost of

reading meters, making out bills, collecting, and all costs which vary with the number of customers. The capacity charge should cover bond interest, general salaries, general expense and all items of expense due to the capacity of the station. The output charge should cover operating supplies, fuel, oil,

| | Per cent. | | Per cent. |
|---|---|---|---|
| Interest on bonds | 16.00 | *Labor:* | |
| *General expense:* | | Dynamo and switchboard men | 1.98 |
| Taxes | 4.10 | Linemen | 3.85 |
| Rents | 1.95 | Mechanics | 1.20 |
| Insurance | 1.25 | Lamp trimmers | 2.25 |
| Injuries and damages | .41 | All others | 2.75 |
| | 7.71 | | 20.87 |
| *General salaries:* | | Rent of power | 3.00 |
| General officers | 2.25 | *Operating supplies:* | |
| Managers and superintendents | 3.20 | Fuel | 15.50 |
| Clerks | 2.55 | Freight | 1.46 |
| | 8.00 | Oil and waste | .95 |
| *Labor:* | | Incandescent lamps | 2.20 |
| Foremen | 1.40 | Carbons | 1.40 |
| Inspectors | .61 | Arc globes | .23 |
| Engineers | 4.20 | Miscellaneous supplies | 2.68 |
| Firemen | 2.63 | | 24.42 |

waste, engineers, firemen and all expense dependent upon the output of the station and profit.

The items previously analyzed would then be divided, approximately, as follows:

| Item. | Consumer. per cent. | Capacity, per cent. | Output, per cent. |
|---|---|---|---|
| Surplus or profit | ... | ... | 20 |
| Interest on bonds | ... | 16 | ... |
| General expense | ... | 7.71 | ... |
| General salaries | 2.55 | 5.45 | ... |
| Labor | 2.25 | 2.75 | 4.20 |
| Labor | .61 | 1.20 | 2.63 |
| Labor | ... | 1.40 | 1.98 |
| Labor | ... | ... | 3.85 |
| Rent of motors | ... | ... | 3 |
| Operating supplies | ... | ... | 24.42 |
| Total per cent, 100 | 5.41 | 34.51 | 60.08 |

Therefore, the total should be apportioned, approximately, as consumer's charge, 5 per cent; capacity charge, 35 per cent; output charge, 60 per cent, or a total of 100 per cent. The rate should then be such that the charges will be in this proportion. These proportions will vary with every plant and the figures are merely used as an illustration, for they represent the average results as shown by Government reports.

The output of the 80 private stations of Missouri for the year 1902 was 49,756,499 kw-hours, with a dynamo capacity of 27,714 kw, or a load-factor equivalent of 1800 hours' use per year or five hours' use per day.

The income from sale of energy was $2,098,622, which is equivalent to earnings of $76.50 per kw-capacity per year, or a net income per kw-hour of 4.2 cents; but as the lost and unaccounted-for current is approximately 30 per cent, the rate charged was 6 cents per kw-hour.

To determine a "readiness-to-serve" rate schedule equivalent to 6 cents per kw-hour the proportions previously determined were applied, giving a consumer's charge (5 per cent) of 0.3 cent; a capacity charge (35 per cent) of 2.1 cents, and an output charge (60 per cent) of 3.6 cents; total 6 cents.

The consumer's charge is usually fixed arbitrarily at $1 per customer per month. This can be lowered as the number of customers increases and the expense per customer decreases.

The "readiness-to-serve" or capacity charge is 2.1 cents per kw-hour for five hours' use per day, which is equivalent to $3.15 per month of 30 days per kilowatt of connected load. The "readiness-to-serve" charge is usually based on a 16-cp lamp equivalent. The readiness charge of $3.15 per kilowatt of connected load worked out would cover 20 16-cp lamps at approximately 15 cents each per month.

The kw-hour charge is 3.6 cents for all current used as registered by the meter.

As it is usual to allow a discount of 10 per cent from the gross bill for prompt payment, it is necessary to add this to the rate for output. This makes the rate 4 cents per kw-hour.

This rate schedule, as expressed to customers, will take the following form:

One dollar per month consumer's charge, plus 15 cents per 16-cp lamp or equivalent connected load, plus 4 cents per kw-hour for current used as registered by meter, less 10 per cent discount for payment by the tenth of the month.

On this rate schedule the rates per kw-hour for different hours use per day are as follows:

| Hours per day. | Hours per month. | Cents. | Hours per day. | Hours per month. | Cents. |
|---|---|---|---|---|---|
| 1 | 30 | 14.5 | 13 | 390 | 4.8 |
| 2 | 60 | 9.25 | 14 | 420 | 4.75 |
| 3 | 90 | 7.5 | 15 | 450 | 4.7 |
| 4 | 120 | 6.6 | 16 | 480 | 4.65 |
| 5 | 150 | 6.1 | 17 | 510 | 4.62 |
| 6 | 180 | 5.75 | 18 | 540 | 4.58 |
| 7 | 210 | 5.5 | 19 | 570 | 4.55 |
| 8 | 240 | 3.3 | 20 | 600 | 4.52 |
| 9 | 270 | 5.2 | 21 | 630 | 4.50 |
| 10 | 300 | 5. | 22 | 660 | 4.47 |
| 11 | 330 | 4.9 | 23 | 690 | 4.45 |
| 12 | 360 | 4.87 | 24 | 720 | 4.44 |

This rate plotted as a curve shows at a glance that the short-hour customers automatically pay a higher rate and the long-hour customers a low rate, and that the longer the use each day the lower the rate. There are no overlapping points as in many of the discount and step rates.

From the foregoing any central station can take its own items of cost as a basis and work out a readiness-to-serve rate which will be approximately correct and will be equitable to the central station and to the consumer, as each consumer will automatically pay a rate per kw-hour proportional to the cost of serving that consumer. The readiness-to-serve rate will discriminate between the profitable and unprofitable customer, and has the advantage of making the bills more uniform throughout the year by lowering the winter bills and increasing the summer bills. The low rate per kw-hour will induce long-hour use of current for advertising purposes, show windows, signs, etc. The author, in conclusion, said that a trial of this rate system will convince any central-station manager that it is the most equitable and satisfactory system yet devised.

### DISCUSSION.

Mr. Hough said in answer to questions in the discussion as to the percentage of electricity lost and unaccounted for that in the Doherty properties it averages 30 per cent. In Denver for the last two years the lost and unaccounted-for energy was 27 per cent, the losses being checked up and looked after more closely there than in the majority of central stations.

In reply to a question as to how many companies are using the Doherty readiness-to-serve rate prescribed in the paper, Mr. Hough said that it was in use in the 40 plants controlled by Doherty interests and in a number of others besides. In the case of power service, the readiness-to-serve charges could be made lower than in the case of lighting if the power load did not come on at the same time as the lighting load, because the lighting load would pay a part of the readiness-to-serve charges.

Mr. P. A. Bertrand, of Jefferson City, said that his company had adopted the Dow system used in Detroit for residence consumers. In this system the consumer is charged a high rate for a certain number of kw-hours per room without regard to the number of lamps connected. Electricity used over and above this amount is charged at a much lower rate. He pointed out that this is more likely to be satisfactory than counting the number and capacity of lamps installed, because this number might change from time to time.

Mr. J. R. Cravath, of Chicago, called attention to another strong point of the Dow system, namely, that it does not discourage residence consumers from putting in convenient lamps in closets, stairways and other places where they are infrequently used, but where they are counted against the consumer if the maximum demand is based on the actual connected load. The maximum demand estimated on the number of rooms in a

house is fully as likely to be correct as a count based on connected load, and does not penalize conveniences.

Mr. Hough said that the investment per kilowatt of capacity for central stations in Missouri was shown by the census to be $575. A new central-station system would cost about $200 per kilowatt of capacity. Prof. H. B. Shaw, of the University of Missouri, made the objection to the Doherty rate for residences that it would make the residence consumer's minimum bill so high that it would be considered prohibitive. He called attention to the fact that the United States census showed a yearly income of $76 per kilowatt of station capacity in Missouri, while the average for the United States was $70. Missouri stations, therefore, averaged above the country at large.

Mr. C. L. Clary, of Sikeston, said that in some cities where the Doherty rate has been used among residence consumers, the readiness-to-serve rate is based on but 30 or 40 per cent of the connected load in residences.

Mr. Hough called attention to some valuable figures averaged from 27,000 residence consumers of the Commonwealth Edison Company, Chicago, in the *Electrical World* of April 8, 1909. These figures showed the ratio of actual maximum demand (as measured by demand meters) to connected load. Figures of this kind, taken from actual experience, will greatly simplify the calculating of rates.

Mr. Bertrand said that the experience of the central-station company at Peoria, Ill., with which he had formerly been connected, was that the best financial returns are from the smaller and medium-sized residences. Such residences yield a higher revenue for a given maximum demand than do large residences. In other words, the revenue per dollar invested in lines and apparatus is higher.

Mr. Hough said that his company required a deposit of $5, which covers possible loss from unpaid bills. This deposit materially cuts down the losses from bad accounts. Taking up the question of flat rates, he called attention to the fact that in many cases the income per kilowatt connected on some of the old flat-rate systems was three times what it is now on a system employing meters throughout.

Mr. P. A. Bertrand said that in many cases customers would object less to paying a flat rate than to paying by meter, even though the total yearly charges might be less with the meter. The increase of bills during the winter months with the meter was a common source of complaint. Mr. W. B. Hays, of Poplar Bluff, said that his company increased its revenue $1,000 per month by the installation of meters. Mr. H. D. Hibbeler, of Washington, approved a flat rate for use in small cottages with tungsten lamps, the rate to be 25 cents per month for each 25-watt tungsten lamp. Mr. R. J. Irvine said that his company makes a residence rate similar to that outlined by Mr. Hibbeler. A flat rate helps to keep up the income in summer. Mr. Hough said that his company had just taken over the central station at Galena, Kan. In that station the income per kilowatt of demand is three times what it is in Joplin and other cities now controlled by the same company.

Mr. R. B. Boyce, of Charleston, said that his company had flat rates up to five years ago. At that time it only had five residence consumers. A flat rate is not favorable to residence business. In three years he had secured 100 residence consumers. He had adopted a rate similar to that used in New Bremen, Ohio. Under this rate an installation used only a quarter of an hour each day pays a very high rate. The rate is reduced the greater the length of time the connected installation is used, the reduction being made in small steps. One of his residence customers has put in a flat-rate controller, and by virtue of this his company counts the maximum demand for which this controller is set, instead of the maximum number of lamps connected.

Mr. P. M. Loewe said that the gross income was higher with flat rates, which his company formerly had, but that the net income was increased by the installation of meters. The meters were installed May 1, and generally resulted in a considerable reduction in the summer bills, the bill for the winter service being much higher.

# INTERIOR WIRING AND ILLUMINATION

## Ornamental Street Lighting at Des Moines, Iowa.

By P. B. Sawyer.

The tendency toward a change in the lighting of the business streets of cities has been productive of a number of varied kinds of installations of lamps, the variation depending upon the local condition and the public spirit of the city's merchants. The forms of lighting range from the temporary installation of festoons of incandescent lamps, which look well at night but are unsightly by day, to the premature installations of artistic systems for continued and efficient service. The best form is that which will give effective lighting, be permanent, and makes a good appearance at all times.

FIG. 1.—STANDARD.

The merchants of a number of the more progressive cities are considering, or are installing, these systems at the present time, and this question has been considered by the Commercial Club, of Des Moines, Ia., which has adopted a system now being installed under the direction and through the efforts of a subcommittee of that organization.

The post adopted (Fig. 1) is 13 ft. 7½ in. high over all, with four 1-ft. 9-in. arms. The light is supplied by five 100-watt tungsten lamps, enclosed in pale opalescent globes; the top globe is 12 in. in diameter and 2 in. larger than the four pendant ones. These posts are installed, under a city ordinance, on the outer edge of the sidewalk of the business streets (Figs. 2 and 3) in a uniform manner. The posts are set 56 ft. from center to center, starting at the street intersection at a point on the curbing opposite the outside property line. The posts are paid for by the owners of the abutting property at the rate of $85 per post, which is sufficient to cover the cost erected. The lighting service is covered by a separate agreement at the rate of $69.50 per post per annum, dusk-to-midnight service, which includes the first installation of tungsten lamps and globes and their renewals; also the painting of the post annually and ordinary maintenance, so long as the lighting agreement is in force. The posts are wired for multiple service, and are switched on and off by a patrolman, who looks after the sign as well. The Des Moines Electric Company acts as contractor in placing the poles and also furnishes the electrical energy.

A brief outline of the developments of the system may be of interest. Members of the Commercial Club who had public

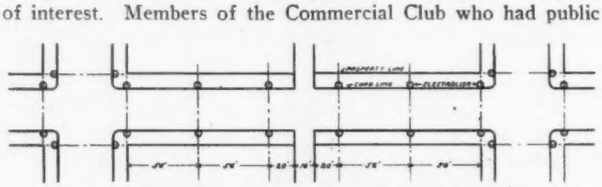


FIG. 2.—PLAN OF STREET LIGHTING.

spirit enough to realize the advantages of this form of lighting proposed at a regular club meeting the investigation of such a system. A subcommittee of the club was appointed and in proper time met and discussed the proposition and called in representatives of the lighting companies, asking for designs, prices, etc., which were obtained and presented at a later meeting. From a large number of ideas, the post (Fig. 1) was adopted and so was electric service. The club then succeeded

in having an ordinance passed by the City Council prohibiting the installation of any other design of post or system of lighting. This done, the next step was to get the system installed. A committee was appointed for each block from the merchants having business in that block. These committees were furnished with blank contract forms (for the installation of posts) which they circulated among their neighbors for signatures. When these were obtained the contracts were turned over to the electric light company, and the poles contracted for were installed. A solicitor then followed up these installations and obtained the lighting agreement. This method is working out quite smoothly and the merchants who are trying to hang back are given no rest by their neighbors until they have agreed to bear their proportion of the lighting scheme.

This system is now installed over approximately one-half mile of streets (Fig. 4) and the progress of the extension is very rapid. The first poles were erected in December, 1908, and the plan of the club is to complete the work in the next nine months. The design is highly ornamental both by day and by night and gives a good distribution of light; the merchants are well pleased and the system is a permanent improvement in the streets.

Des Moines is a growing city, having a population of about 85,000; is situated near the center of the State, and the lighting system is one of the many modern improvements now being made that will assist in making it a center of activity in the Middle West. Some interesting facts in central-station practice in Des Moines appeared in the March 11 issue.

FIGS. 3 AND 4.—WALNUT STREET, DES MOINES, BY DAY AND BY NIGHT.

## The Tungsten Lamp from a Central-Station Manager's Standpoint.

Mr. Paul M. Loewe, of the Moberly Gas & Electric Company, read a paper dealing with the benefits of the tungsten lamp to the central-station industry, at the convention of the Missouri Electric, Gas, Street Railway & Water Association, at Springfield, Mo., April 15.

A little over a year ago Mr. Loewe said that he received a case of 100-watt tungsten lamps from a manufacturer and a letter asking him to hold these lamps until a representative would call. When the representative came he had not only sold every lamp, making a guess at the price, but had put three gasoline plants out of commission. The tungsten lamp will not reduce the amount of energy used by consumers. As it is human nature to look for something for nothing, the consumer lets his lamps burn longer, talks of the fine light he has, tells his friends about it, and at the end of the month willingly pays as large a bill as ever.

If a company furnishes free carbon-lamp renewals, the removal of this burden is quite an item to the central station. The tungsten lamp will soon come down to a more conservative price. Mr. Loewe spoke in a very appreciative manner of the good work done by manufacturing companies in assisting central-station managers to work out practical problems of illumination as they come up, this service being performed free of charge. There are still people who use coal oil, and this is not always a case of poverty, but simply a case of staying in the same old rut. For the price at which energy is sold to-day, the laboring man can enjoy the luxury of electric light as well as the rich man.

Certain prospective customers when approached will always raise the objection that they cannot afford to pay as much as some neighbor who has very high bills. This is where the tungsten lamps get a customer. The central-station manager immediately uses the argument that with the new tungsten lamp such high bills are not necessary, and the prospect is induced to have his house wired. One of Mr. Loewe's customers was on the point of putting in a gasoline plant because his bills ran so high with the carbon-filament lamp. Just before the deal was closed, Mr. Loewe persuaded him to make a trial of tungsten lamps. This reduced his bill materially during the summer months, and there was no more kicking about the size of the bill.

### COMPARISON OF TUNGSTEN AND GASOLINE LAMPS.

Mr. Lowe, in considering the case of a given room equipped with tungsten and gasoline lamps, allowing the same rated candle-power per square foot, said that no data would be of universal application, because the prices of gasoline and electric power (the latter especially) vary widely. He therefore computed the monthly cost of the two systems for a certain definite assumed case, that of a large room of ordinary finish and height equipped with:

1. Bowl-frosted tungsten units, rated at 100 watts and 80 horizonal cp, equipped with bowl reflectors.

2. Gasoline lamps equipped with chimney and mantle, burning at a gravity pressure of about 12 in. of water and using 2.2 gal. of oil per mantle per 100 hours.

The dimensions of the room were 40 ft. x 40 ft., and the area to be lighted was consequently 1600 sq. ft. One rated candle-power per 3 sq. ft. was used or a total of 533 cp, or seven 80-cp, 100-watt lamps. The following table gives the results:

| | Tungsten. | Gasoline. |
|---|---|---|
| Hours burning per month | 120 | 120 |
| Horizontal candle-power of unit | 80 | 30 |
| Number of units | 7 | 25 |
| Assumed cost of energy per kw-hour, cents | 10 | 16 |
| Cost of supply per month | $8.40 | $10.69 |
| Monthly cost lamp renewals (800-hour basis) | 1.95 | ..... |
| Cost of chimneys and mantles (renewed once in 270 hours) | .... | 1.40 |
| Total monthly cost for illumination | 10.35 | 12.09 |

A gasoline lamp of the kind described will average not over 30 horizontal cp and will consume per month of 120 hours 2.7 gal. per mantle. The light distribution is mainly horizontal owing to the absence of an efficient reflecting device. Mantle lamps, especially the upright type, are not well adapted to efficient reflectors owing to difficulty with respect to a fixed relation between the source of light and reflector; to the deterioration and darkening of mantles and chimneys; to the presence in some types of metal parts directly under the lamp, and to the

small incentive for development by reflector manufacturers along these lines.

It is a safe estimate that not more than 75 per cent as much useful light per rated candle-power is given by the upright-mantle gasoline lamp as by the tungsten, "useful light" meaning the light upon the working plane. This light is commonly taken at a height of 30 in. above the floor of the room.

DISCUSSION.

Mr. C. W. Hough, of Joplin, said that his company is operating two systems of series-tungsten street lighting. So far they had lost no lamps from burnouts, but had lost 30 lamps during an exceedingly severe wind storm. His company was competing with 25-cent natural gas with the aid of tungsten lamps.

Mr. Loewe said that the use of tungsten lamps had caused a reduction of about 75 per cent in the number of free carbon-lamp renewals required at Moberly. In 401 working days his company had put on 381 new consumers, many of them gained through the introduction of the tungsten lamp. (The population of Moberly is about 8000.)

Attention was called in the discussion to the recently inaugurated practice of the Union Electric Light & Power Company, of St. Louis, of selling tungsten lamps to consumers at 25 per cent below list price. It was claimed that the result of this practice has been that large wholesale merchants, who were central-station customers, in St. Louis would be requested by their customers over the State to purchase lamps for them and that these lamps were being purchased and shipped over the State to the detriment of the business of local supply dealers.

Mr. Fred L. Benson, of the General Electric Company, said that the Commonwealth Edison Company, in Chicago, although selling tungsten lamps below the listed price, prevented their use except on the company's lines by requiring one of the company's carbon or tungsten lamps in exchange for each tungsten lamp sold at a low price. Mr. Benson said that it seemed likely in the near future that some alloy of tungsten would be found which would be less fragile and which would make a tougher lamp filament, although at the expense of some loss of efficiency.

Mr. R. B. Boyce, of Charleston, spoke enthusiastically of the benefit his company had derived from the introduction of tungsten lamps. Six gasoline plants had been put out. In fact, he jocosely remarked that had it not been for the increased business brought about by the tungsten lamp he might not have had money enough to come to the convention.

Mr. Loewe said that he had noted in the *Electrical World* the co-operation that other central stations had secured with the contractors in their territory. He had gone to work accordingly on the same line. By all electrical interests working together in the town 14 out of 42 gasoline installations had been put out of business by the tungsten lamp.

Prof. H. B. Shaw, of the University of Missouri, said that the tungsten lamps tested so far at his laboratories had averaged below rated candle-power, the range being from 1.3 to 1.9 watts per mean horizontal candle.

## Electric Sign and Display Work at Rockford, Ill.

The Rockford Electric Company, of Rockford, Ill., has been doing some good work under the management of Mr. F. H. Golding both in securing electric sign business and in producing attractive window displays in its own office windows. The business centers of Rockford being scattered into three districts it is difficult to show by any one photograph the work that has been done in sign and display lighting. Fig. 1, however, shows one of the principal streets. The sign in the distance is about

FIG. 1.—WEST STATE STREET, ROCKFORD.

FIGS. 2 AND 3.—ELECTRIC SIGN BY DAY AND BY NIGHT.

FIG. 4.—ELECTRIC SIGN.

a quarter of a mile away across the river. This distant sign, which is that of the Rockford Lumber & Fuel Company, is notable on account of its size; it is shown again in Figs. 2 and 3. It is 6 ft. high and 170 ft. long, and contains 300 lamps. Along

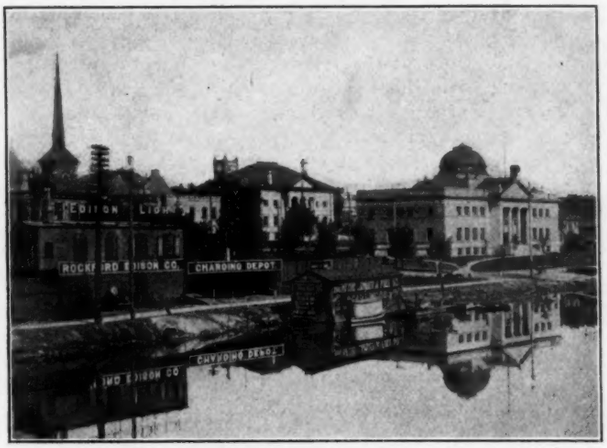



FIG. 5.—SIGNS OF ROCKFORD ELECTRIC COMPANY.

the top of the sign are lamps in dense opal globes which serve to top off neatly the supporting posts of the sign. The lamps are of only 2 cp and yet the sign is very legible at a distance. In fact, its legibility is due to the fact that the letters are clean-

FIG. 6.—WINDOW EXHIBIT.

cut and the lamps are of low candle-power, so that there is no blurring effect.

About 75 per cent of the signs connected are on a flat rate and are turned on and off by the company's patrolman. There are 160 signs, with a total of 10,000 lamps connected, most of these lamps being of the 2-cp type. Fig. 4 shows one sign which is rather striking in effect. One of the company's own signs, on its property along the river bank, is shown in Fig. 5.

The company has two window exhibits in its own office window. These exhibits are changed frequently. In one is shown applications of motors to machine tools made in Rockford. Fig. 6 shows a window trimmed for a bedroom in order to exhibit all electric bedroom conveniences.

The company has begun to experiment with 4-cp, 10-volt, tungsten sign lamps, using a 110-volt to 11-volt transformer at the sign.

# LETTER TO THE EDITORS.

## Grounded Secondaries.

*To the Editors of Electrical World:*

SIRS:—I wish to express my appreciation of the arguments by Mr. W. J. Canada in your first issue of April in favor of grounded secondaries, and of your editorial endorsement of the arguments. Why any element connected with the electric-lighting industry should oppose the grounding of the secondary is inexplicable, and it would be most interesting to know the motive of such opposition, which is in striking and most unfavorable contrast to the broad spirit shown by the underwriters in favoring, on humane grounds, a practice which they might, as possibly adverse to their monetary interest, join the National Electric Light Association in opposing. Mr. Canada states that the grounding of the secondary is now advocated by practically all engineering societies and by a majority of electric light and power companies, which latter statement is borne out by the result of his canvass on that subject. In view of this approval of the practice, and the willingness of the underwriters to accept it, one is naturally puzzled at the persistent though veiled opposition of the National Electric Light Association, which, moreover, thus far has apparently not deigned to offer any technical reasons for its attitude. The necessary corrective could be applied by the American Institute of Electrical Engineers, but while this body has formally placed itself in favor of grounding the secondary, it apparently hesitates to take any decisive action in the matter, as indicated by the failure, noted in your columns, of that body to represent its views at the recent meeting of the Underwriters' National Association, though entitled to membership in the committee which reported on the subject.

If there are any reasons against grounding the secondary sufficiently strong to counterbalance the safety to life through such grounding, they should be made public; in the absence of such a statement, the opposition to grounding appears entirely indispensable, and against the interest of the electric lighting industry.

CHICAGO, ILL. CHARLES S. DAWSON.

# DIGEST OF CURRENT ELECTRICAL LITERATURE

*Abstracts of the important articles appearing in the electrical periodical press of the world*

### Generators, Motors and Transformers.

*Alternators.*—H. BRUHN.—A translation of his recent German paper on the e.m.fs. induced in the exciting winding of single-phase alternators. The author examines the reaction of the armature current on the field winding in a single-phase generator, and shows how the e.m.f. induced in the several turns depends on their position, which becomes of importance in machines having cylindrical rotors with distributed windings. The result of the investigation shows that, in addition to the e.m.f. which appears at the slip-rings, other e.m.fs. exist inside the winding. Although the latter pressures neutralize one another, and, therefore, set no pulsating currents in the exciting circuit, yet, owing to their possible magnitude, they may become dangerous to the insulation.—Lond. *Electrician*, April 16.

*Automatic Speed Control of Motors.*—A note on a recent British patent (7811, 1908; April 8, 1909) of Sir W. G. Armstrong, Whitworth & Company, Ltd., and F. Harlow. Motors, the speed of which is controlled by varying the field strength of the generator, are liable to stop if the torque is suddenly increased, and to prevent this result it is necessary to decrease the resistance in the generator field circuit. This is effected automatically by means of two rotating contacts, which, when they touch, short-circuit a portion of the field circuit resistance. One contact is on the motor shaft, and the other is fixed to a copper disk, driven by the motor through a spring coupling.

The copper disk rotates in a magnetic field. Below a certain speed the contacts touch, but above this speed the braking effect produced by eddy-currents in the disk causes the disk to lag and the contacts to separate.—Lond. *Elec. Eng'ing*, April 15.

*Synchronous Alternating-Current Motor.*—F. B. Crocker and M. Arendt.—An article illustrated by numerous diagrams, giving an elementary explanation of the action of the synchronous single-phase alternating-current motor.—*Gen. Elec. Review*, May.

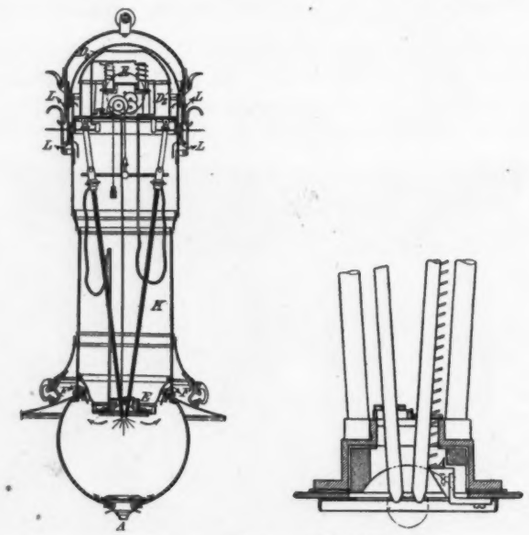
*Polyphase Commutator Motors.*—E. Roth.—The first part of a theoretical article in which the author develops a general vector diagram of polyphase commutator motors; it contains other well-known diagrams as special cases.—*La Lumière Elec.*, April 10.

*High-Speed Direct-Current Generator.*—A note on a recent British patent (7327, 1908; April 1, 1909) for the field construction of high-speed direct-current dynamos of the British Thomson-Houston Company and F. H. Clough. The field system is constructed like the stator of an alternating-current induction motor, and is provided with shunt and series windings, the series coils occupying slots in the pole face between the slots containing the shunt winding. The armature has a fractional pitch winding, the demagnetizing conductors of which correspond in position with the magnetizing conductors of the stator-series winding. A flat neutral commutating zone, equal in width to the difference between the pitch of the armature winding and the space enclosed by the shunt winding, is obtained.—Lond. *Elec. Eng'ing*, April 8.

**Lamps and Lighting.**

*New Standard of Candle-Power of Light.*—W. A. Harwood.—An abstract of a paper read before the Manchester Section of the (British) Inst. Elec. Eng. The author proposes a "secondary" standard, which may be stamped once and for all with a given candle-power and will retain its value for an indefinite period, thus obviating the necessity of more than two sets of photometer readings. The new standard consists of the light emitted by a fixed area of an incandescent metal strip heated electrically. Of various metals tried pure platinum has proved most suitable for the purpose. The method of adjustment depends on the different absorbing qualities of black fluorspar and water for waves of heat and light. Of the total radiation emitted by a heated platinum strip, the percentage which is absorbed by black fluorspar is found to increase as the temperature of the strip is raised, while the percentage absorbed by water diminishes. As one particular temperature of the strip is raised these two percentages are equal and their equality fixes the conditions of the strip uniquely. In the actual apparatus two parts of the radiation from the strip pass through a plate of black fluorspar and a layer of water respectively, and fall on two sensitive thermopiles which are connected in opposition through a galvanometer. The adjustment consists in regulating the current so that the galvanometer deflection is zero. Up to the present the strip has been photometered against an incandescent lamp at constant voltage, with very satisfactory results.—Lond. *Electrician*, April 16.

*Arc Lamps.*—B. Monasch.—The first part of an illustrated paper read before the Hamburg Electrical Society on recent European direct-current arc-lamp practice. The enclosed arc lamp, which has found so much favor in the United States on account of the greatly reduced cost of attendance, has not found as much favor in Germany. It has been modified in Germany in order to increase the candle-power at the expense of the long life. This is done in the so-called "economy" arc lamp, which has only one single globe and thinner carbon electrodes than are used in enclosed-arc lamps. A 6-amp lamp with 7-mm electrodes and a clear globe has a mean lower hemispherical candle-power of 1100 hefner candles. A 5-amp lamp with 6-mm electrodes gives 725 candles. With an anode of 300 mm and a cathode of 100 mm, the life is about 22 hours. Bremer started a new era by using impregnated carbon electrodes. He also came back to the old idea of placing electrodes side by side, slightly inclined against the vertical. In order to get a perfect circulation and carry off the vapors, so as to avoid their deposition on the lamp globes the Allg. Elek. Ges. uses the arrangement shown in Fig. 1. The air enters at *A* and passes along the inner surface of the globe without disturbing the quiet burning of the arc. The vapors developed in the arc are carried off through the openings *F*. If any of the vapors should get into the upper space *K*, they are carried off through *L* into outside air. None of the vapors can get into the regulating mechanism. With this kind of ventilation, the loss of candle-power due to vapors deposited on the globe is less than 5 per cent in 18 hours. It is now possible to use three arc lamps with pure carbon electrodes in series across a 100-volt circuit without any serious resistance. Similarly it has recently become possible to connect three intensive flame-arc lamps in series across a 110-volt circuit or six such lamps across a 220-volt circuit. For this purpose special electrodes ("plania intensive triplex") are used. The author uses the name of "intensive" arc lamps for all lamps in which two electrodes are placed side by side so as to emit an intensive light perpendicularly downward. Beck was the first to devise an arc lamp without any regulating mechanism. Another arc lamp of this kind, designed by F. Janecek and built by the Allg. Elek. Ges., is shown in Fig. 2. A piece of sheet iron is inserted longitu-



FIGS. 1 AND 2.—ARC LAMPS.

dinally in one of the electrodes. Teeth are cut out of this sheet, as shown in the illustration. The lowest tooth rests on the porcelain piece *A* and upholds the electrode. This iron tooth is subjected only to the radiating heat of the arc. Under this influence it gradually softens, bends and the electrode slides down until it is held by the next tooth and so on. The two electrodes are mechanically coupled together by something like a scissor coupling (not shown in the illustration). The arc is lighted by bringing the two electrodes in contact by a magnetic device. In order to protect a system of two such arcs in series at 110 volts against any variation of voltage, they are connected in series with an iron resistor in a hydrogen atmosphere, such as the Nernst lamp ballast. In general, arc lamps without a special regulating mechanism are liable to get out of order. Carbone uses two pure carbon electrodes side by side. According to the author, the most important technical advance in arc-lamp design is due to Blondel, who uses carbon electrodes with relatively very thick impregnated cores. Such electrodes are made for white and yellow light and for 30 volts or 40 volts at the arc. In 110-volt networks, three lamps, each of 30 volts, can be used, in series with a resistor of small resistance, or two lamps of 40 volts each. This last type of lamp with electrodes giving white light is now being introduced on several of the largest streets of Berlin, to replace the old pure-carbon arcs. The author seems to have quite a favorable opinion of the Blondel arc lamp, and discusses how far the flame-arc lamp

with Blondel electrodes one above the other is better for street lighting than the intensive flame-arc lamp or other arc-lamp types. He thinks this lamp is especially favorable in competition with inverted incandescent gas lamps of high candle-power. The article is to be concluded.—*Elek. Zeit.*, April 15.

*Disk-Arc Lamp.*—An illustrated note on a new arc lamp of English make, in which the ordinary carbon rods are replaced by disks of carbon; these are controlled by a mechanism which feeds the carbons by the simultaneous rotation of both disks, so that the periphery of each disk is burned away uniformly. The arc is struck by separating the disks, the extent of movement being independent of the size of the disks. This type of lamp has very short over-all dimensions; a 10-amp lamp measuring not more than 20 in. over-all. The lamp can be used as a flame, enclosed, or open arc lamp, with suitable electrodes, and it is claimed will burn 50 per cent longer than any ordinary lamp. A magnetic field is employed to give stability to the arc. —Lond. *Electrical Review*, April 16.

*Tungsten Lamp.*—H. SCHROEDER.—A paper illustrated by diagrams showing the superiority of the tungsten series lamp over the carbon series lamp and the conditions under which the tungsten lamp is cheaper to operate than incandescent gas lamps.—*Gen. Elec. Review*, May.

### Generation, Transmission and Distribution.

*Small Water Falls.*—H. J. S. HEATHER.—A paper read before the South African Association of Engineers on a convenient method of utilizing a series of small water falls. A power plant is erected at each fall, but only one is equipped with an ordinary synchronous generator, exciter and regulating switches, the others being equipped with non-synchronous induction generators. This arrangement results in a great saving of wages.—Lond. *Electrician*, April 16.

*Small Gas Plant.*—A. H. GIBSON.—An abstract of a paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. The author tested the combined efficiency of a suction gas producer and gas engine capable of developing 24 hp. The fuel used throughout was gas coke containing 81.75 per cent of carbon and 1.19 per cent of hydrogen, and had a net calorific value of 12,635 lb.-Fahr. units per pound dry. The general conclusions to which the experiments led are as follows: The composition and calorific value of the gas vary greatly with the quantity of water vapor supplied to the vaporizer, as does the thermal efficiency of the producer, the latter attaining its maximum value, namely, 78.6 per cent, when the gas produced has its highest calorific value—that is, 127 lb.-Fahr. units per cubic foot at 32 deg. Fahr. under a pressure of 29.921 in. of mercury. The efficiency of the engine, however, falls off as the gas becomes richer, the reduction of thermal efficiency of the producer being accompanied by a reduction in the percentage of heat rejected to the jackets, and in an increase of the thermal efficiency of 26.9 per cent and a minimum efficiency of 22.8 per cent, based on the brake horse-power. The over-all thermal efficiency of the plant has a maximum value of 18.16 per cent based on the brake horse-power, this occurring with a slightly greater vapor supply than that (0.4 lb. per pound of dry fuel) giving the maximum producer efficiency.—Lond. *Electrician*, April 16.

*Fuel Economy.*—J. IZART.—The first parts of a long paper in which the author discusses the reasons of the great difference in specific fuel consumption obtained in various central stations. The necessity of paying more attention to the possibilities of improving the fuel consumption by continuous control of the operation and tests is pointed out. In the last installment the author gives an entropy diagram for saturated-steam and superheated-steam calculations.—*L'Industrie Elec.*, Feb. 25, March 25, April 10.

*Motors in a Cotton Mill.*—An illustrated description of the electric motor equipment of a large ring-doubling cotton mill in the Manchester district. Some particulars are given of the nature of the machinery to be driven and the motor switchgear, etc., employed. Energy is taken from the mains of the Manchester Corporation, and induction motors are used throughout.—Lond. *Elec. Eng'ing*, April 15.

*Centrifugal Pumps.*—A. BARBEZAT.—The conclusion of his paper on centrifugal pumps. The author gives diagrams which facilitate their predetermination and also gives examples of the use of his diagrams.—*La Lumière Elec.*, April 3.

*Mine Fan.*—An illustrated account of some tests of an electrically driven mine fan, showing an over-all efficiency of 76.6 per cent when taking about 400 hp.—Lond. *Elec. Eng'ing*, April 15.

### Traction.

*Overhead Conductors.*—P. DAWSON.—A continuation of his long and fully illustrated serial on electric traction on railways. In this installment the author first considers the many objections which have been raised against the use of the third-rail for main-line electrification, and then proceeds to discuss the use of overhead conductors, dividing the latter system into those where two overhead conductors per track are necessary and those where only one conductor per track is required. The construction of the overhead work is also considered in detail.—Lond. *Electrician*, April 16.

### Installations, Systems and Appliances.

*Russia.*—C. SCHMIDT.—An article on central stations in Russian towns, with a relatively large area and a small and poor population. The author recommends in general the three-wire direct-current system with 440 volts between the outers. The kerosene lamp used in most cities for street lighting can be replaced without increasing the cost of operation by metallic-filament lamps. The author recommends the use of metallic-filament lamps of at least 50 cp at a height of about 5 m (16.5 ft.) above ground and at a distance of 40 m or 50 m (132 ft. or 165 ft.) from each other. In general two kerosene lamps are to be replaced by one metallic-filament lamp.—*Elek. Zeit.*, April 15.

*Parallel Connection of Resistors.*—P. FEHMERS.—A description of a graphical method of determining the joint resistance of resistors connected in parallel. The method is thought to be specially suitable for calculating starting and braking rheostats. —*Elek. und Masch.* (Vienna), April 11.

### Wires, Wiring and Conduits.

*Paper for Cable Insulation.*—C. BEADLE AND H. P. STEVENS. —The first part of an article in which the authors point out that information at present available upon the desirable properties of paper from the insulating point of view is very meager. The authors attempt to fill this gap by giving the results of their experience in dealing with such papers from the chemical point of view. The composition of manila and other papers is briefly discussed. Tests to which papers should be subjected are considered, and a number of tables of results are given. The effect of the moisture is dealt with at some length, and the authors finally express their opinion on changes taking place when papers are in contact with the atmosphere and when they are protected from it. The paper is to be continued.—Lond. *Electrician*, April 16.

*Transmission Line.*—J. LISTON.—A fully illustrated description of the 32,000-volt Schaghticoke-Schenectady transmission line of the Schenectady Power Company, which has a length of 21 miles.—*Gen. Elec. Review*, May.

### Electrophysics and Magnetism.

*Effect of Air Blast on Spark Discharge.*—J. A. FLEMING AND H. W. RICHARDSON.—An abstract of a paper read before the Physical Society of London on the effect of an air blast upon the spark discharge of a condenser charged by an induction coil or transformer. When an oscillatory discharge of a condenser takes place across the spark-gap in the usual manner by charging the condenser from an induction coil or transformer, the intermittent spark which takes place is a complex effect. It consists partly of a true condenser discharge and partly of an alternating-current arc due to the current coming directly from the induction coil or transformer. This arc discharge is a source of difficulty in making accurate quantitative measurements with electrical oscillations, and to produce a uniform oscillatory discharge this true arc discharge must be prevented or arrested. This can be done by a regulated air-blast pro-

duced in any convenient manner, thrown upon the spark-gap, provided that the spark-gap is small. As a proof of the advantages to be obtained from this arrangement a number of measurements were given of the decrement and spark-gap resistances of various circuits measured with the Fleming cymometer, with and without the air-blast upon the spark-gap. It was shown that the observations were more regular and the resonance more accurately delineated when the spark-gap was thus treated with an air-blast. The paper also described experiments made to investigate the effect of breaking up the spark-gap into smaller spark-gaps in series, both when the gaps were subjected to an air-blast and also without an air-blast. It was shown, up to a certain length of gap, about 2 mm in the case of this experiment, that the air-blast had a very decided effect in increasing the mean square value of the current, and also that a similar effect was produced by dividing up the spark-gap into smaller spark-gaps in series, provided that the total spark-gap was not increased beyond a certain limit. This increase appears to be due to the suppression of the arc discharge, as shown by the appearance of the image of the spark in a revolving mirror. With regard to the multiple spark-gaps, the general result, however, appears to be that beyond a small limit in length, about 3 mm, nothing is gained by breaking up the spark-gap into spark-gaps in series, or by subjecting the spark-gap to an air-blast.—Lond. *Electrician*, April 16; *Elec. Eng'ing*, April 15.

*Effect of Electrolytes on Colloids.*—E. F. Burton.—An account of an experimental investigation, the chief results of which are as follows: For a copper colloidal solution, the particles of which are positively charged (that is, move to the cathode), the influence of added electrolytes on the velocity of the particle has been determined. The electrolytes used were potassium ferrocyanide and aluminum sulphate. Evidence has been produced to show that it is the ion bearing a negative charge that is active in reducing the velocity. This power of the negative ion depends on the valency in a way analogous to the valency relations found by Picton and Linder, and by Hardy, for the coagulative power of ions. The discharging power of two negative ions of the same valency is the same. Observation on the coagulation produced in each case shows that the particles coagulate when they lose their charge.—*Phil. Mag.*, April.

*Electricity in the Atmosphere.*—M. Makower, Margaret White and E. Marsden.—An abstract of a paper on the electrical state of the upper atmosphere, read before the Manchester Section of the (Brit.) Inst. Elec. Eng. It contains the results of the investigations made during July and August, 1908. These were chiefly concerned with the measurement of the electric currents flowing from a kite down a wire by which it was attached to the winding machine. In the first experiments different lengths of wire were let out with the kite, detached from the winding machine, and the end of the wire attached to an ebonite insulator fixed to the ground. The kite was then connected to earth through a sensitive dead-beat galvanometer and the current measured. In these experiments the currents at considerable heights were so large that it was found necessary to reduce the sensitiveness of the galvanometer by shunting. The plan was therefore adopted in later experiments of using a portion of the kite wire when attached to the drum of the winding machine, which was earthed, as a shunt, and thus making use of the usual daily flights taking place at the Glossop Observatory. The mean currents obtained were as follows:

| Height of kite above ground. | Current in amperes. |
|---|---|
| 2,000 ft. | $5\times10^{-8}$ |
| 4,000 ft. | $13\times10^{-8}$ |
| 6,000 ft. | $23\times10^{-8}$ |

The current at any fixed height varied considerably from day to day. There seemed, however, to be a fairly close connection between the current and wind velocity, the currents being great when the wind was high. A few experiments were made on the potential of the air at different heights, but no very reliable results were obtained, on account of the difficulty of satisfactorily insulating the apparatus owing to the high potentials to be measured.—Lond. *Electrician*, April 16.

*Corpuscular Theory.*—B. J. Spence.—An abstract of an American Physical Society paper on the number of free corpuscles per unit volume of the metals gold, platinum and silver. Drude has developed in his work on the optical properties of metals a theory of dispersion, based on the assumption that in the metals there exist two kinds of corpuscles, conducting and vibrating. The author simplifies somewhat Drude's equations and calculates the number of corpuscles for gold, silver and platinum.—*Phys. Review*, April.

*Skin Effect.*—W. E. Miller.—A second paper illustrated by many diagrams giving various formulas for calculating the skin effect. A numerical table is given for evaluating the different mathematical functions in these formulas.—*Gen. Elec. Review.*—May.

### Electrochemistry and Batteries.

*Artificial Graphite.*—An illustrated description of the equipment of the works of the International Acheson Graphite Company, at Niagara Falls, with special reference to E. G. Acheson's recent inventions in the field of soft unctuous graphite.—*Electrochem. and Met. Industry*, May.

*Carborundum and Silicon.*—An illustrated description of advances made during the last years by the Carborundum Company, of Niagara Falls. Details are given of new applications of carborundum; of a new abrasive aloxite, produced as a by-product in making ferro-silicon; and of the production of metallic silicon by the processes of Tone.—*Electrochem. and Met. Industry*, May.

*Electric Hardening Furnaces.*—A. Sabersky and E. Adler.—An account of experiments with a furnace intended for hardening steel articles and employing an electrically fused salt bath. Figures of the cost of operation are given. —Lond. *Electrician*, April 10; *Electrochem. and Met. Industry*, May.

*Experimental Electric Furnaces.*—C. A. Hansen.—An illustrated description of the results obtained with a small experimental furnace of the Héroult type, giving details of construction, consumption of electrodes, power consumption, metallic losses, slags and quality of output.—*Electrochem. and Met. Industry*, May.

*Ions.*—G. Rosset.—A theoretical note on "the period of electrolytic vibration of ions" and its consequences.—*La Lumière Elec.*, April 10.

### Units, Measurements and Instruments.

*Integrating Photometer.*—An illustrated description of an integrating photometer devised by H. Krüss. As shown in Fig. 3

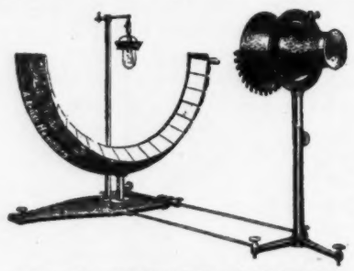


FIG. 3.—INTEGRATING PHOTOMETER.

it is quite similar to the instruments of Matthews. There is a half circle or a circle of mirrors $S$ and the lamp to be tested is placed in the center of the circle. The light emitted from the lamp is reflected by each mirror and falls on the lens $O$. There

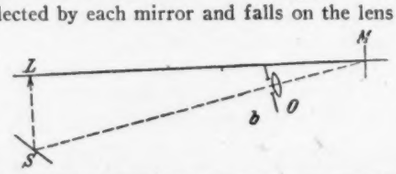



FIG. 4.—DIAGRAM SHOWING PRINCIPLE OF PHOTOMETER.

is a lens to each mirror. As shown in Fig. 4 there is a slit $b$ before each lens $O$ and the slit openings of the different lenses are adjusted according to the well-known cosine law. The light passing through the different lenses is focused at the point

*N* and there measured in any convenient way. As the slits *B* are adjustable it is possible to use only one lens by closing up the other slits to determine the polar curve of the lamp.—*Jour. f. Gasbel.*, Vol. LI, 1908, p. 597; abstracted in *Elek. Zeit.*, April 15.

*Standard Resistors.*—C. C. PATERSON AND E. H. RAYNER.—An illustrated description of the construction of non-inductive water-cooled standard resistors for precision alternating-current measurements. The resistors described were designed to carry currents from 50 amp to 2000 amp, and range from 0.04 ohm to 0.001 ohm. As it was desired to obtain a voltage drop of two volts or more across the potential points, a considerable amount of power had to be dissipated, and water cooling had to be resorted to. The resistors are in the form of manganin tubes through which water circulates. It has been found that the smaller sizes can be loaded up to currents giving voltage drops more than double the above figure, without the temperature rise causing a change in resistance of more than 2 parts in 10,000. The watts per square centimeter, which are dissipated under the "maximum" load conditions, vary from 7½ to 12. An upper limit of 10 watts per square centimeter may be taken as an average value for the design of manganin tubes up to 1.5 mm thickness of wall. This corresponds to a current density of about 25 amp per square millimeter (16,000 amp per square inch) in tubes 0.3 mm thick. In the larger sizes an internal glass tube is provided so that the water only flows in the annular space between this and the outer manganin tube. Measurements have shown that the effect of the resistance of the water is unappreciable. Self-induction effects are avoided by leading the potential wires back along the resistors in such a way that the magnetic flux, which causes the back e.m.f. of self-induction in the resistor, will also give rise to a practically equal back e.m.f. in the lead of the potential circuit, and so neutralize the induction effect. In order to make this elimination more complete, and also to render the calculation of the inductance possible, it is necessary that the potential lead shall take the form of a closely fitting cylindrical sheath running the whole length of the tube and insulated from it at all points except at one end. In the tubes in question the thickness of this insulation is 0.2 mm.—Lond. *Electrician*, April 16.

*Testing Cables.*—H. OHLSON.—When testing short lengths of highly insulated wire with a D'Arsonval galvanometer of about 1000 ohms, and a universal shunt of 10,000 ohms set for a multiplying power of 1, in order to obtain the greatest sensitiveness, the movement of the coil is extremely sluggish, if the short-circuit key be closed during the test for the purpose of checking the instrument, zero. Further, on opening the key before the battery is applied there is a small deflection, although no charge may be in the cable core under test. Both

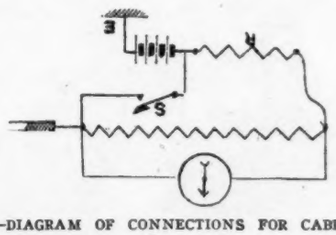



FIG. 5.—DIAGRAM OF CONNECTIONS FOR CABLE TEST.

these troubles are due to the alteration of the permanent shunting of the galvanometer when the short-circuit key is opened or closed, the shunt being 10,000 ohms with key opened, and practically a short-circuit across the coil with key closed. Both disadvantages can be overcome by the insertion (Fig. 5) of a high resistance (100,000 ohms is convenient) at *R* between battery and traveling connection. Inserting a resistance in the galvanometer circuit, as is sometimes done, decreases the sensitiveness of the instrument considerably, but this arrangement does not affect it. This resistance is not required when capacity is being measured, as *S* remains open throughout the test, and it should always be removed unless the capacity is very small. For determining the constant of the galvanometer, *R* may either be cut out or added to the resistance in circuit. It is not necessary to use it when the multiplying power of the universal shunt is greater than about 5, as then the shunting of the galvanometer changes little with the short-circuiting at *S*.—Lond. *Elec. Review*, April 16.

*Testing Insulation Resistance.*—R. G. ALLEN.—A paper illustrated by many diagrams read before the Dublin Section of the (British) Inst. Elec. Eng., on testing the insulation resistance of live cables on direct-current systems.—Lond. *Elec. Review*, April 16.

*High-Frequency Currents.*—H. DE GRAFFIGNY.—A description of a device for producing high-frequency currents for therapeutic purposes, and especially of a modification, due to J. Gourier, of the old apparatus of D'Arsonval and Oudin. This modification consists in supplementary shunt coil wound around the resonator coil and which impresses its effect on that of the resonator.—*La Lumière Elec*, April 3.

*Analysis of Periodic Curves.*—J. FISCHER-HINNEN.—An illustrated description of an analytical and graphical method for the resolution of a periodic curve into its fundamental wave and higher harmonics. The method is claimed to be suitable for the use of electrical engineers not specially skilled in such work.—*Elek. und Masch.* (Vienna), April 11.

### Telegraphy, Telephony and Signals.

*Testing Wireless Telegraph Receivers.*—J. A. FLEMING AND G. B. DYKE.—An abstract of a (London) Physical Society paper on the production of steady electrical oscillations in closed circuits, and a method of testing radiotelegraphic receivers. There is great difficulty in conducting comparative tests of receivers in actual radiotelegraphic stations, but owing to the small radiative property of closed circuits, it is practicable to use two such circuits, one as a transmitting station and the other as a receiving station, at a distance of a few hundred yards; this is practically equivalent to stations with open oscillators at very large distances. Methods were described for producing in one of the closed circuits extremely constant damped oscillations by means of an induction coil or transformer, a spark-gap on which a steady jet of air is allowed to impinge, and a suitable mercury break. The receiving circuit consists of a small circuit of insulated wire, which is pivoted in any such manner that it can be turned in any direction, the angular deviations with a condenser being measurable on scales. This circuit is joined in series with a condenser of variable capacity, and with the oscillation-detector to be tested. If the oscillation-detector is of the current-actuated type it is placed in series with the condenser; if of the potential-actuated type it is placed across the terminals of the condenser, being associated with a shunted cell and telephone if necessary, or with a telephone simply, if a magnetic detector is used. It is then possible to set this receiving circuit in such a position that it has no current induced in it by the oscillations in the transmitting circuit; but on turning it through a certain angle, sounds are heard in the telephone indicating the production of oscillations in the secondary circuit. The angle through which it is to be turned is a measure or indication of the sensitiveness of the detector.—Lond. *Elec. Eng'ing*, April 15.

### Miscellaneous.

*Lightning Discharge.*—C. C. F. MONKTON.—An illustrated description of an interesting case of a lightning discharge, showing a preference for a copper path rather than a course along an iron pipe of approximately equal ohmic resistance.—Lond. *Elec. Eng'ing*, April 15.

## BOOK REVIEWS.

THE LADY OF THE DYNAMOS. By Adele M. Shaw and Carmelita Beckwith. New York: Henry Holt & Company. 310 pages. Price, $1.50.

With its wealth of incidents, its dramatic changes of fortune, its great personalities, it is strange that the electrical art has not inspired more fiction. But the truth is, perhaps, that novel

writers have not yet had time to acquaint themselves with the new opportunities and are a little afraid of the new technique. We are glad to encourage the authors of the present sprightly and interesting volume with the suggestion that other parts of the field keen with episodes as worthy of their pens as those which here concern a young American electrical engineer installing a hydro-electric plant in the beautiful Island of Ceylon. Miss Shaw is well known as a fertile producer of admirable short stories, while Miss Beckwith has become well known in the journalism of electric light and power.

The narrative takes us from the selfish society life of New York direct into the green glooms and lights of tropical life, where the hero finds his "lady of the dynamo," and where by a strange twist of fate the other woman follows him. There is acute human interest in every page of the development, while the technical part relative to the plant, the dam and the power transmission is cleverly and briskly worked out. Possibly the authors have founded their story on fact; it is certainly true that in the enterprises of this kind that are now taking electrical engineers into so many remote parts of the world, an abundance of exciting adventures presents itself. We can heartily commend this swiftly moving story, with its fine local color, as one of the books for the coming summer months.

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The Street Railway System of Metropolitan Boston. By A. E. Pinanski. New York: McGraw Publishing Company. 58 pages. Price, $1.

This book, which is printed in pamphlet form, deals with the development of the street railways, the franchises, the finances and present condition of the Boston railways and suggests methods for improving the service. It is evident that much care has been exerted to render the treatment accurate, and the author claims to have made use of 30 public documents, 33 monographs, 49 technical articles, 11 newspaper discussions and 16 contributions from private sources. The magnitude of the system discussed will be appreciated when it is known that the Boston elevated railway alone handles half as many passengers per year as all of the steam railroads in the United States combined carry in the same time. The merit of the discussion can be judged from the fact that for it the author was awarded the Baldwin Prize, offered by the National Municipal League for the year 1908, for the best essay dealing with the relation of the municipality to the transportation service.

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The Copper Handbook. A manual of the copper industry of the world. Vol. VIII, 1908. Houghton, Mich.: Horace J. Stevens. 1500 pages. Price, $5.

The eighth annual edition of Mr. Stevens' compendium of the copper industry, covering the year 1908, contains 1500 pages and almost 50 per cent more matter than the previous edition. The principal portion of the book is devoted to a detailed description of the copper mines of the globe, details being given of no less than 6767 properties. Copper is considered under a great variety of heads in the preliminary chapters of the book, these giving, in non-technical language, a vast amount of information relating to the geology and mineralogy of copper and copper ores, with chapters devoted to mining, milling, smelting, leaching and refining, and yet other chapters treating of the history of the metal, brands, grades, substitutes and uses. The complete glossary of mining terms is reprinted from Vol. VII. The final chapter, devoted to statistics, is most complete and its authority has been recognized officially and by the copper trade. As usual, the "Copper Handbook" is exceedingly frank in its comments, and the descriptions of mining companies considered by the author to be dishonest are marked by the utmost limit of plain speaking.

# NEW APPARATUS AND APPLIANCES

## A Modern Hospital Power Plant in San Francisco.

By C. F. Braun.

Following the destruction of its old hospital building in the San Francisco disaster, the Southern Pacific Company immediately began plans for a new and larger institution. As a site, an entire block facing on the beautiful Golden Gate Park, was secured and in February, 1908, work was begun on what is now the most complete industrial hospital in the United States, a hospital capable of caring for over 250 patients. It may be interesting to the reader to know that this hospital is supported by the employees themselves, by a tax of 50 cents per month, levied on each employee, who in return is insured the best medical care and attendance in case of sickness or accident.

Heat, light, motive power and water are supplied by a very complete isolated plant, which it is the purpose of this article to describe. The power plant is located in a modern concrete and brick structure, in which utility and architectural beauty have been harmonized, and as is characteristic of the other parts of the institution, no expense has been spared to give the plant a finished and pleasing appearance. The boiler settings are of glazed brick, the engine-room floors of maroon tile and the engine finish is exceptionally fine, all exposed pipe and fittings being of finished brass.

Steam for the engine-generator units, for the Webster heating system and for hot-water service, is supplied by a battery of two 150-hp water-tube boilers, operating at 160-lb. pressure. California crude oil is the fuel used, the fuel-handling apparatus consisting of two 4.5-in. x 2.75-in. x 4-in. duplex steam-driven pumps, which draw oil from a 10,000-gal. storage tank outside the building footings, passing it through heater and strainer to the burners. The heating of the oil is accomplished by means of a small coil on the outside of which the oil-pump exhaust is allowed to pass. A set of 5.25-in. x 3.5-in. x 5-in. duplex steam-driven boiler-feed pumps, a set of 6-in. x 9-in. x 12-in. direct-acting vacuum pumps for the heating system, and a 400-hp Webster open heater complete the boiler-room equipment.

The stack is a part of and harmonizes with the rest of the building. It is 36 in. in diameter and 50 ft. high, the lower 20 ft. being lined with vitribestos tile.

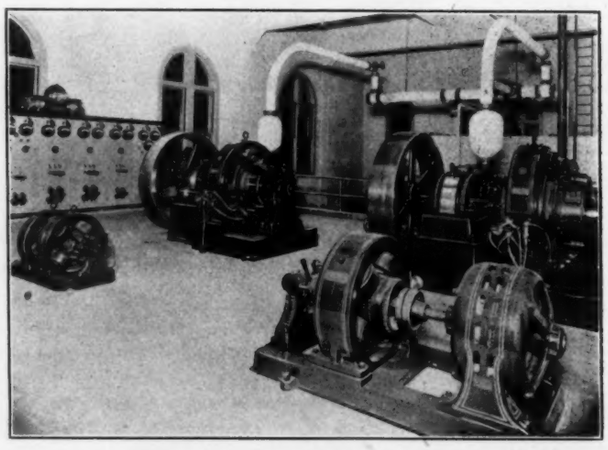


FIG. 1.—ENGINE ROOM OF HOSPITAL POWER PLANT.

All pipes from the boiler-room to the main building are led out through a 4-ft. x 8-ft. reinforced-concrete tunnel, which passes on a level from the boiler-room floor directly underneath the engine-room and thence to the buildings. The engine exhaust pipes are led into this tunnel, as are also all

drip pipes and all electric wiring to and from the generator-room.

In view of the demand for direct current by special apparatus and by elevators throughout the hospital it was decided to install a direct-current plant, the distribution to be on a three-wire system. High-efficiency, 125-volt lamps are used throughout, and elevator and other motors are operated at 250 volts.

The generating equipment is of special interest in that two-wire, 250-volt generators were used, unbalancing of the three-wire system being accomplished with a motor-generator balancing-set. With this arrangement exceptional regulation and results have been obtained.

The main generating equipment consists of two 75-kw, 250-volt, two-wire direct-current generators, each directly driven by a 120-hp simple automatic engine running at 275 r.p.m. A 30-kw, 250-volt, two-wire direct-current generator directly driven at 900 r.p.m. by a two-phase induction motor is provided as an auxiliary, the motor being connected to the local electric supply company's service mains. The series-field coils of the machines are adjusted for 10 per cent over-compounding. The voltage rise is proportioned to the load increase, making the compounding curve approximately a straight line.

The motor-generator balancing set, which is connected across the three-wire system, was designed to regulate within 2 volts with a maximum current in the neutral wire of 150 amp, but it

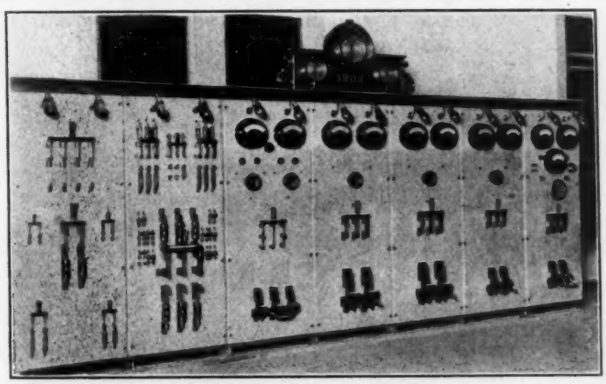


FIG. 2.—SWITCHBOARD IN HOSPITAL POWER PLANT.

will be seen later this figure has been surpassed. The connections for this balancing set are such that the shunt-field winding of each machine of the set receives energy from the opposite side of the system, this tending to raise the voltage on the low side. The series-field coils of each machine of the balancing set are in series with the armature of the opposite machine thereby compounding one machine with the armature current of the other. The arrangement is such that at each moment the machine acting as a generator is cumulatively compounded, while the machine acting as a motor is differentially compounded. The cumulative compounding on the generator tends to raise the voltage on the low side and the differential compounding of the motor tends to increase the speed. When running under unbalanced load the motor takes considerably more current than does the generator, and if it were compounded with its own current it would tend to flash over much sooner than when compounded with a smaller current of the generator; the generator being compounded with the larger motor current has a stronger tendency to hold the voltage up. Under test and without any movement of the brushes or rheostats this set showed the following regulations:

| Current in neutral. | Volts, motor side. | Volts, generator side. |
|---|---|---|
| 0 | 116.7 | 116.7 |
| 30 | 117.2 | 116.3 |
| 70 | 117.8 | 115.8 |
| 130 | 117.1 | 115.6 |
| 150 | 115.5 | 116.9 |

It is thus seen that the e.m.f. varies from normal by only 1 volt, or less than 1 per cent, this regulation being obtained through the entire range of the balancing set automatically and without any operation whatever of the rheostats. The machines reverse their functions, passing through zero to the opposite extreme with the same results. The writer believes that no three-wire machine can produce such satisfactory results. The balancing set has the additional advantage in that for long, continued unbalancing on the system the rheostat can be adjusted so that the voltages on the two sides of the system are exactly equal. The standard regulation guaranteed for three-wire generators is 2 per cent above and below normal. As far as service is concerned, then, the two-wire machines with balancer seem to be far preferable.

For operation the balancer set requires 7.5 amp, which represents its no-load loss. This loss, however, is offset by the greater efficiency in the two-wire generator over that of the three-wire machine, additional windage and friction in the three-wire machine bringing the efficiency of this type of machine to at least 2 per cent below that of the two-wire machine of equal rating. When the use of standard two-wire apparatus, simplified wiring and reduction of first cost are further considered, the superiority of the three-wire generator in any respect to an arrangement such as this, is not in the least apparent. The danger of violent short-circuiting encountered in "throwing in" some three-wire machines in parallel is also eliminated with the use of the balancer. The electrical machinery was built by the Electric Machinery Company, of Minneapolis, Minn.

The switchboard consists of seven panels, three generator panels, a panel for the induction motor, a balancer-set panel and two distributing panels, one lighting and one motor. The panels are of uniform size, 30 in. x 76 in., of a single piece of blue Vermont marble 2 in. thick.

On each generator panel are mounted a voltmeter, an ammeter, a double-pole plain overload circuit-breaker, the field-circuit rheostat and a three-pole knife switch, through the middle pole of which the equalizer load is connected to the equalizer bus.

On the motor panel are mounted an ammeter for each phase, a voltmeter with plugs and receptacles, a double-pole plain overload circuit-breaker, a triple-pole main switch and a large hand-wheel for operating the motor starter at the rear of the board.

On the balancer panel are mounted a differential ammeter, a differential voltmeter, a triple-pole plain overload circuit-breaker, two field rheostats, a triple-pole double-clip rheostatic starting switch, and also the ground-detector lamps of the system. The switching arrangement for the balancer set is very simple. The three-pole double-clip switch serves to start the balancer, cut-out resistance and connect the neutral, and is absolutely fool-proof.

All distributing switches on the lighting panel are of the double-throw type, the lower studs being connected to a separate set of buses that are joined to the local company's alternating-current mains. Thus light for the hospital is insured without running any machinery whatever in the plant. If, however, energy for the motors is required, the motor-generator set must be started. The institution is thus protected even in the case of entire shut-down of the steam plant.

Above the board and supported by ornamental copper work are mounted the engine-room clock and boiler steam gages.

All metal work on the board, including instruments, is copper-finished, and the board is in general keeping with the handsome appearance of the plant.

In view of the fact that all exhaust would be made use of in the steam and hot-water systems, a highly economical engine was not particularly desired, but rather a simple engine with good regulation and with few parts to give trouble. American Ball simple engines with 14-in. x 12-in. cylinders were installed.

To secure a good and sufficient water supply wells were sunk to a depth of about 100 ft. The water was found to be so exceedingly gritty that an air lift was determined upon as being superior to any form of plunger pump. A small 6-in. x 8-in. air compressor, driven by a 5-hp motor in the boiler-room, provides the air. The air-lift delivers the water to the

suction pipe of a 2-in. centrifugal pump driven by a 3-hp motor, which, in turn, forces the water to the large supply tank located on the roofs of the various main buildings. This arrangement has been found to be very satisfactory, the gritty water having no deleterious effects on the air-lift or pump-runner. The capacity of the pumping equipment is 7200 gal. of water per hour.

Great care has been exercised throughout to make the plant a model one. Mr. D. J. Patterson was supervising architect, and the Standard Engineering Company, power engineers, of San Francisco, installed the plant, the boilers, however, being supplied by the Parker Boiler Company.

## Battery Charging Rheostats for Direct Current.

For use wherever a small storage battery is maintained, as in public and private garages, where only constant-voltage direct current is available, a storage-battery rheostat is now being sold by the Westinghouse Electric & Manufacturing Company. Some form of resistance must be employed since the voltage at the beginning of the charge is less than is required when the batteries are fully charged, and it is therefore necessary to reduce the voltage, usually by an adjustable series rheostat. The voltage applied to the battery should be raised gradually from the minimum value at the beginning to about 2.7 volts per cell at the end of the process. The illustration shows a type "DB" battery-charging rheostat for 40 to 44 cells, which is capable of carrying 50 amp on any position; other rheostats are supplied for the same current capacity to charge 10 to 14 cells from 110-volt to 120-volt circuit.

To select a charging rheostat for a given service, the circuit voltage, the minimum allowable battery voltage and the charging current in amperes must be known. The required rheostat resistance can then be computed as follows:

$$\text{Resistance of rheostat} = \frac{\text{circuit volts} - \text{battery volts}}{\text{amperes charging current}}$$

The battery voltage is the product of the number of cells in series and the volts per cell. For example, to charge a battery which has 36 cells connected in series, at a maximum rate of 7½ amp from a 110-volt circuit, the minimum voltage or the initial charging voltage being 2 volts per cell, the resistance in the rheostat would have to be as great as

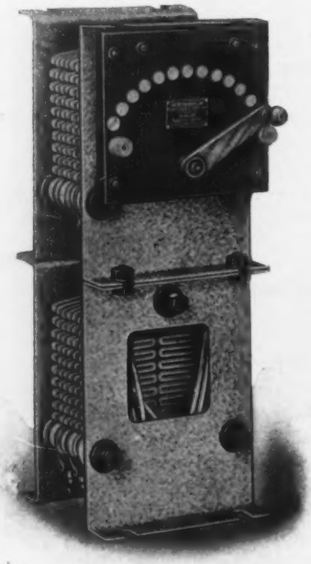
$$\frac{110 - 36 \times 2}{7.5} = 5.07 \text{ ohms approximately,}$$

and the standard rheostat with 5½ ohms resistance would be required.

Although these rheostats are rated as for 110 volts to 120 volts, it is possible to use them on higher voltages provided the resistance is great enough to keep the current within the maximum allowable amperage for the batteries, but, of course, the current capacity of the rheostat must not be exceeded.

These rheostats have a standard finish of black marine for the face-plate; the resistance grids are coated with aluminum paint, and the supporting frames are galvanized, making rusting impossible. The general appearance of the complete rheostat is such that it can be mounted near any switchboard without forming a displeasing contrast.

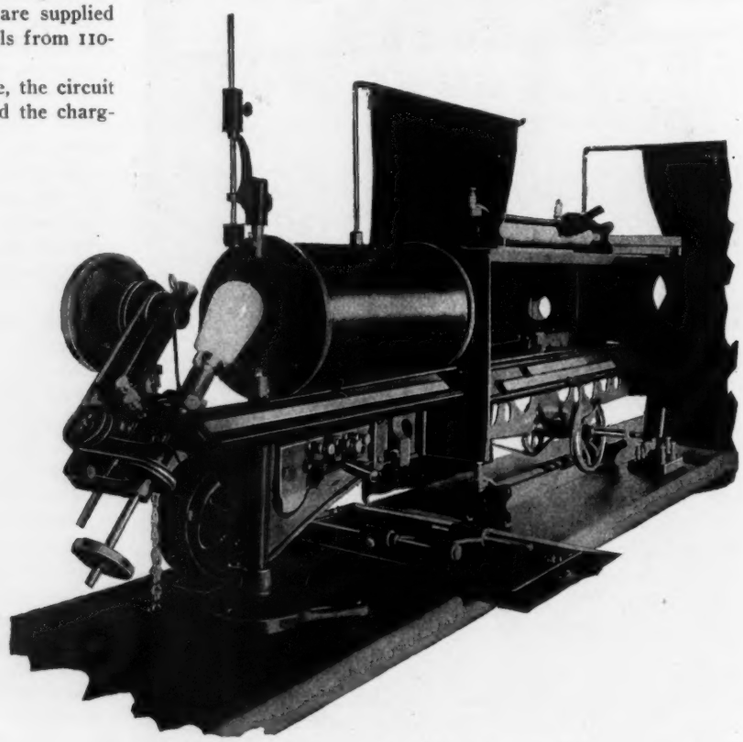
The resistance is of the grid type and is rigid, compact and substantial, insuring a long life if not abused. There are 13 steps by which the resistance can be adjusted, giving ample opportunity for maintaining the current at the correct value. The entire construction is particularly suited for operation by persons unfamiliar with electrical appliances.



BATTERY CHARGING RHEOSTAT.

## Spherical Photometer.

The spherical photometer illustrated herewith is built by the Dwyer Machine Company, of Lynn, Mass. By its use end-on, angular, mean spherical and horizontal measurements can be taken, and its special features adapt it to the measurements of reflector lamps and the determination of the value of reflectors attached to lamps. The general construction of the instrument is shown in the engraving. The revolving mechanism consists of a mean spherical jig for rotating the lamp while in a vertical or horizontal position or at any intermediate angle. By means of an index wheel the lamp may be fixed at every 10 deg. The frame of the photometer is of cast iron machined to insure alignment and accuracy of distances. The bar consists of a V-track and the car is provided with wheels to match, to prevent wabbling and to keep the screen square with the rays of light. The bar is enclosed by planished iron hoods which cut out light from windows, doors, etc., from the screen. The interior surfaces of the instrument are lined with black velvet and large curtains protect the operator reading the screen so



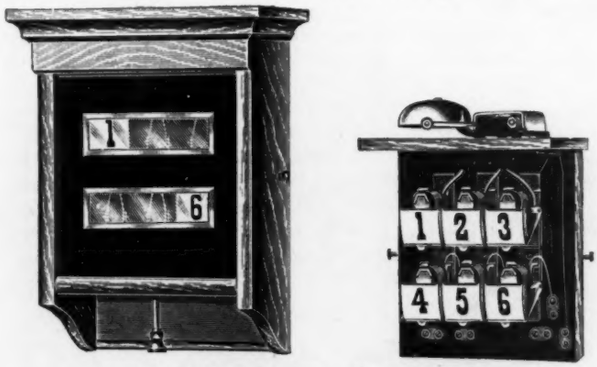
SPHERICAL PHOTOMETER.

that light from the end lamps shall not interfere with the accurate reading of the differences in the reflections on the screen. The car is controlled by a tiller wheel so located that its operation does not tire the arms. A foot treadle starts and stops the rotating socket, which may be driven by belt or by an independent motor. Binding posts and flexible connections are provided for voltmeter and ammeter, and by means of two rheostats, fine gradations of potential may be secured. The scales read directly in candle-power. Two sizes of instruments are made: a 60-in. size having a range of from 1 cp to 50 cp and a 72-in. size with a range of from 1 cp to 100 cp.

## Drop Annunciator.

The increasing demand for a good, reliable annunciator, due to the erection of so many new modern office buildings, hotels and apartment houses has led Edwards & Company, Inc., to place on the market a new type of lock gravity-drop annunciator, known as "The Dixie." This type has the same fine cabinet work and finish which are characteristic of the Edwards annunciator, and in addition, has several new features. The well-known 8-B Lock gravity drop, which is positive in operation and thoroughly reliable, is supplied in this type as well as the standard bells and buzzers used on all Edwards annunciators.

The annunciator is in two parts, the back board and the case. On the back board (see Fig. 2) the bell, drops and connectors are mounted. When the annunciator is to be installed the case is unhooked and removed, there being no screws to take out or



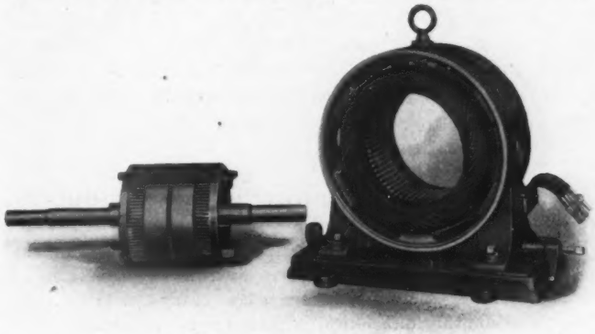

FIGS. 1 AND 2.—DROP ANNUNCIATOR.

replace, and the back board is screwed to the wall. Connections can be easily made, as the connectors are in plain view at the bottom of the back board, and it is not necessary to work through or between the drops. Since the bell is also on the back board, a test can be made while the case is off and the working parts exposed. When the work of installation is completed, the case is held in place by substantial hooks, thus protecting the instrument from dust or damage.

Another desirable feature of the annunciator is that the marking is printed on a paper board, which is slipped into the shutter, so that it can be easily changed when necessary. The indicators are large and very distinct, and as there are no indications in sight except when a call is made, any confusion as to what particular call was made is avoided. Only a small amount of current is required to operate these drops because of their simplicity and ease of operation.

## Polyphase Induction Motor.

The accompanying illustration shows the stator and rotor of a polyphase motor which is typical of a line built by the Ideal Electric Manufacturing Company, of Mansfield, Ohio, for frequencies of 25, 30, 40 and 60 cycles and for tensions of 110, 220, 440, 550 volts and over. The design is characterized by massive frames, cast-iron end housings, amply proportioned phosphor bronze bearings, form-wound stator coils threaded into partially closed slots, and heavy shafts. The machines are designed to carry 25 per cent overloads for two hours without abnormal temperature rise, and 50 per cent overloads for short intervals. The motors are constructed for floor, wall or ceiling attachment. Standard belted motors are provided with rails for belt tightening, the rails serving as a support for the motor when used for wall or ceiling suspension as well as for ordinary

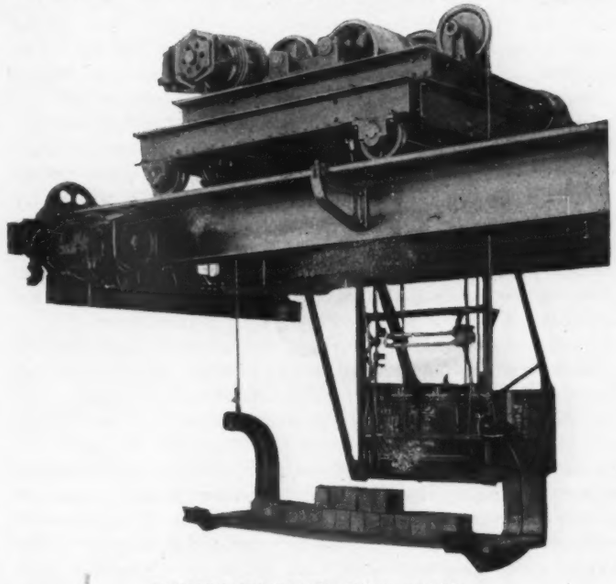


POLYPHASE INDUCTION MOTOR.

floor attachment. Motors larger than 7½ hp are provided with starters which reduce the pressure applied to the windings during the starting period. The starter comprises an auto-transformer and an oil-immersed controller for making the change from the starting to the running positions. In the small sizes for low-voltage motors, the auto-transformers and controllers are mounted together, but in the larger sizes each is mounted separately and both are immersed in oil.

## Three-Motor Electric Traveling Scale Crane.

The accompanying illustration shows a new type of scale crane, designed and manufactured by the Whiting Foundry Equipment Company, Harvey, Ill. All movements are operated by electricity. The novel feature of this crane consists in the application of the scales for weighing material which are supported on trolley truck frame and carry the hoisting mechanism mounted on independent steel framework. The scale beams are in the cage suspended from the trolley and readings are taken and recorded by the operator. There are three beams: two scale beams with self-recording poises and one tare beam, en-



ELECTRIC TRAVELING SCALE CRANE.

abling scale weights to be determined of several different items of material with ease and accuracy. A simple movement of hand-lever transfers, when desired, all load from the knife edges of the scale to the trolley truck frame, and then operation is the same as with ordinary trolley. The former method of crane

weighing consisted of hanging a scale device on the hook. This required a special man to read, enter and calculate weights and deduct the tare, a process much more laborious than with the new arrangement, which also eliminates the liability of personal error. The scale device on the hook also occupied considerable head room, which was often a consideration of importance. An open-side platform is furnished, as shown, for carrying long pieces such as rods or bars. The design of this platform is made to suit the material to be handled. A crane of this type is most useful in loading material, checking invoiced weights, and in loading for shipment, for inventory, etc.

## Developments in Bituminous Gas Producers.

For a number of years the Westinghouse Machine Company has been engaged in the development of a satisfactory form of producer suitable for gasifying the usual grades of bituminous fuels. The unusual difficulties encountered in the utilization of this kind of fuel have resulted in the trying out of many different types, both of the producer itself and of the necessary auxiliaries for producing clean gas. For the past year and a half, however, the company has been engaged in carrying out upon a commercial scale a producer plant which is now upon the market. These tests have not been conducted with a toy apparatus, but with a full-sized equipment of 175 hp, including a standard gas engine of about the same power, by means of which the actual power value of the gas produced and the over-all efficiency obtainable were determined without possibility of error.

The above-mentioned tests were brought to a conclusion on April 3, by drawing the fire in the producer after it had been in continuous operation on various loads and on various fuels for a year past, these 12 months having been devoted to tests of one to four weeks' duration, both 10 and 24 hours per day on standard fuels available for power purposes. These fuels included Pittsburgh slack and run-of-mine, lignites from northern Colorado, Texas and South America, as well as peat and other fuels from various parts of the country. During most of the tests the load on the equipment was maintained at full rating, although one special test of one month and a half duration was made to determine accurately the standby loss of the producer standing idle.

The drawing of this fire after one year's operation was made the occasion of a demonstration of the producer plant before Government officials and engineers from various parts of the country especially interested in bituminous gas practice. The fire was drawn without trouble or interruption, as large clinker formations were entirely absent, although the producer had, just previous to this occasion, been running on a full-load test for one month, using Pittsburgh coal. The lining of the producer was found to be practically intact and in quite good enough condition for continued operation for an unlimited period. A detailed examination of the piping leading from the producer house to the engine on test showed that during this long period of operation there had been no deposits of tar or lampblack. As a matter of fact, this piping had not been examined for about two years and a half of producer experimentation.

The most important feature of the demonstration was the entire absence of tar formed in the producer gas. A similar examination of the mixing and inlet valves of the engine used for the past year on this test showed practically no deposits of tar or lampblack, such as would interfere with the operation of the engine. The Westinghouse plant uses no tar extractors, as no tar is made; there is simply a static washer of small size in the place of the usual bulky coke scrubber. A rotary exhauster draws the gas from the fuel bed and delivers it to the engine at a definite pressure. No gas holder is used in this process, as the producer regulation is entirely automatic. The gas produced has a moderate heat value suitable for high compressions in the gas engine, and is uniform and clean, average samples showing not more than 00.2 to 0.03 grain per cubic foot in impurities. The ash is fairly clean, and analysis of samples from time to time shows that not more than 1 per cent to 3 per cent of the combustible in the coal escapes in the ash.

The various fuels which have been used in this producer on test have been gasified successfully and have run as high as 34 per cent moisture, 35 volatile and 15 per cent ash and 1½ per cent sulphur. The results of the tests show that with coal, such as Pittsburgh slack or run-of-mine, an over-all economy of 1.1 lb. per brake hp-hour can be secured, equivalent to a little over 0.9 lb. per hp-hour. Moreover the producer efficiency does not vary more than 10 per cent from full load on the plant to no load.

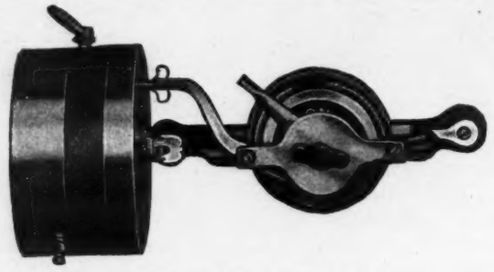
The results of this past year's tests have fully convinced the builders that the apparatus experimented with possesses unusual commercial value, and preparations are being made for extensive manufacture. A plant of this type has been in operation for over six months on Colorado lignite coal with equal success, as evidenced by an order recently placed with the Westinghouse Machine Company for a duplicate equipment.

## Electric Time Switch.

The use of time switches is rapidly increasing as their various applications become generally known, and these conditions have created the demand for a simpler or less complicated device than has frequently been secured in the past. To meet the demand for a switch of reasonable price, having capacity up to and including 35 amp, the type shown herewith has been developed and is being marketed by the Central Electric Company, Chicago, Ill.

The switch mechanism is of the well-known double-pole type and so located as to be operated by means of a tripping mechanism controlled by a standard clock. To operate the device it is only necessary to close the switch and set the clock at any hour it is desired to have the switch opened. At this predetermined time the clock releases the locking toggle and the switch is instantly thrown open by a suitable controlling spring.

Time switches have been found especially useful in connection with the sale of energy on a flat-rate basis—that is, where lamps are to be switched on or off at definite hours on a fixed charge



ELECTRIC TIME SWITCH.

for current. Energy rent for tungsten lamps is being sold on this basis in many cities. In stores and apartment houses the use of time switches not only effect a great saving in energy used, but what is often more important, assures punctual service that attendants will not give. In small stores it often happens that everyone is busy at the time when the lights should be turned on. In apartment houses the halls are frequently dark through forgetfulness or absence of the janitor. With a time switch the lights are always on and off at the right time.

When show windows or signs are located near theaters or other places of amusement, it is very desirable to have them illuminated while the crowds are passing. The time switch can be set to turn the lights off at any desired time and makes a trip to the store unnecessary. The time switch can also be successfully used in public or private illuminating plants for controlling service at a flat rate during specified hours. There are many other situations where it can be used for convenience and profit as, for instance, in charging automobiles or storage batteries of any kind and in every place where the current should be turned on and off at definite hours.

## Catenary Bridges for Electric Railways.

The accompanying illustrations show styles of catenary bridge construction used by the Syracuse, Lake Shore & Northern and

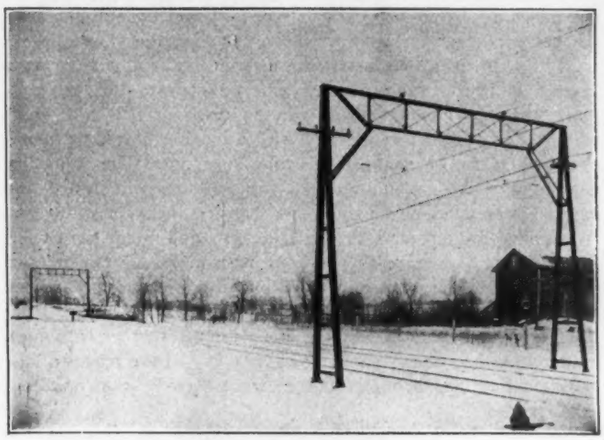


FIG. 1.—BRIDGE FOR DOUBLE-TRACK ROAD.

the Rochester, Syracuse & Eastern railroads. The bents of the bridge are 28 ft. center to center.

The bridges, which are placed 300 ft. apart, support a No. 4-0 grooved copper trolley wire by means of hangers suspended

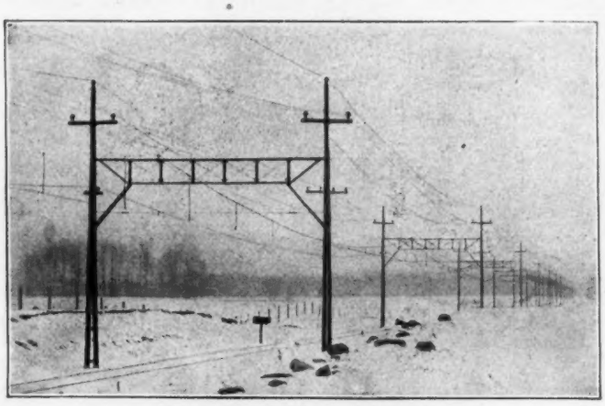


FIG. 2.—BRIDGE USED WITH THREE-PHASE TRANSMISSION LINES.

from the catenary messenger wire at 30-ft. intervals. On the construction on the Syracuse, Lake Shore & Northern Railroad 7/16-in. strand steel messenger wire was employed, mounted

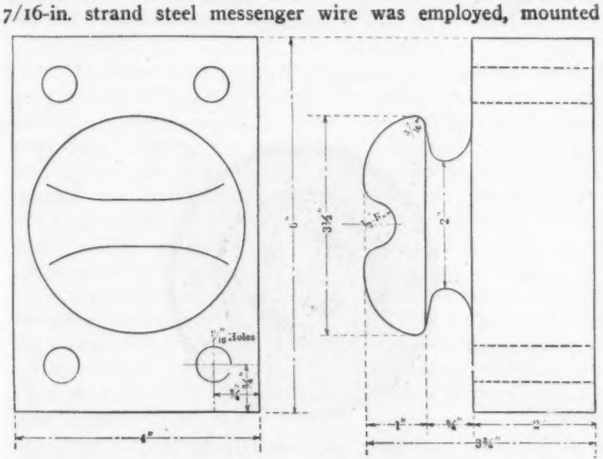


FIG. 3.—PORCELAIN INSULATING SADDLE.

on porcelain-pin insulators attached to steel pins on the top member of the bridge. On the construction on the Rochester, Syracuse & Eastern Railroad it is proposed to use the two 500,000-circ. mil copper feeders as messengers, and thus eliminate the cost of the steel messengers. The copper messenger is to be carried on a porcelain saddle (Fig. 3) recently designed by Mr. Thomas H. Mather, chief engineer, and Mr. R. A. Dyer, Jr., electrical engineer of the railroad company. These saddles, which are to be furnished by the Ohio Brass Company, are to be lagged to a timber, which will be protected from decay by preservative compound, and are to be mounted on the tops of the catenary bridges. This timber provides additional insulation and is a safety precaution against grounding in case the insulator should break.

These bridges were designed to be comparable in price with the ordinary wooden-pole construction. It is said that the total cost of construction per mile of double track on the Syracuse, Lake Shore & Northern Railroad was $4,100, as compared with $3,325 for an equivalent wooden-pole construction. The elimination of the steel messenger will result in a saving of $400 per mile. These bridges were built by the Archbold-Brady Company, Syracuse, N. Y.

## Waverly Electric Ambulance.

The Waverly Company, Indianapolis, has recently completed for the Indianapolis Board of Trade an electric ambulance, which is claimed by the makers to be the handsomest and most modern power-driven ambulance ever constructed. The dimensions of the new ambulance are as follows: Length, 14 ft. 1 in. over all; wheel-base, 8 ft. 1½ in.; length inside, 8 ft. 5 in;

ELECTRIC AMBULANCE.

width over all, 5 ft. 10 in.; width inside, 3 ft. 10 in.; height over all, 8 ft. 4 in.; height inside, 5 ft. 4 in.; height of sill, 32¾ in.; height of step, 19 in.

Special points of convenience are two side doors 23 in. wide near the front of the ambulance opening upon an open space of 18 in. x 3 ft. 10 in. in front of the stretchers for the use of the surgeon and attendants. Convenient to this space are electric-light buttons, an electric heater, special drawers for surgical instruments, and appliances for the control of folding seats and stretchers. The interior of the ambulance is handsomely finished in polished hard woods with russet leather curtains and upholstery. The exterior is painted in white enamel, with the words "City Dispensary" in blue letters on the side panels. In the glass of the center window on each side is displayed a large red cross on a white circle.

An exceptionally powerful motor has been provided, with large overload capacity, such as is used on commercial vehicles in heavy service. This is operated by a 42-cell, 13-plate battery, constructed for unusual mileage and speed, which last varies from 3 to 15 miles an hour in ordinary service, with a special emergency speed of 20 miles an hour. A four-speed controller, so designed as to enable the car to start and accelerate without shock, is an important feature of the equipment, and this with the noiselessness of the rotor, driving system and gear make this new construction an ideal piece of mechanism, considered either from the point of view of the operator or that of the patient.

## Electrically Operated Valves.

In steam stations it is often desirable to operate a valve from a distance so that in cases of emergency it will not be necessary to approach a valve to shut it off. Also when large

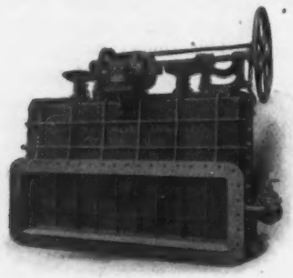


FIG. 1.—ELECTRICALLY OPERATED EXHAUST VALVE.

units are started and stopped with any frequency, motor-driven valves for large exhaust piping, for instance, will materially expedite matters. It is not uncommon, therefore, to find in

FIGS. 2 AND 3.—ELECTRICALLY OPERATED VALVES.

large steam stations electrically operated valves between the boilers and the steam header, or between sections of the header or between the header and engines. Where space is limited or where the locations are disagreeable or difficult of access, motor-operated valves are well adapted. In hydraulic stations where heavy construction obtains, so that the opening and closing of valves and sluice gates by hand would take not only considerable time, but labor as well, valves operated from the switchboard possess an added advantage besides that of being motor-operated. By means of tell-tale lamps the position of the valve can be indicated, and where the water is brought in a pipe line from a reservoir some distance away, the installation of electrically operated valves at the intake or at some intermediate point in the line is a safeguard against damage. The Chapman Valve Manufacturing Company, of Indian Orchard, Mass., builds a line of electrically operated valves for various purposes. The body, cap and plug are made of various materials as called for by standard construction, and the motors are specially designed for valve use. The direct-current motors have solid hand-hole covers to exclude dirt and moisture, and the alternating-current motors have solid heads. The windings are treated by immersion in hot asphaltum in vacuum and the bearings are of a special form requiring no lubrication whatever. The windings are designed to give the motor great starting torque with low speed. There are no contact devices to cut out the motor at the end of the travel of the valve. The plug is forced to its seat and the motor being then overloaded, the overload device on the controller releases and the circuit is broken. No external resistance is used in starting the motor. There is a lost motion, or "hammer-blow," device which allows the motor to bring the gears to speed, at which point the yoke nut receives a heavy "hammer blow," starting the plug from its seat. By the use of such a device a large motor is not required. Should it be desirable at any time to operate the valve by hand, the motor and gearing can be disconnected in a short while. The hand-wheel is fitted with a locking device by means of which it can be engaged with the yoke nut. The controller usually furnished is mounted on the wall or switchboard and has asbestos-lined cover and fiber barriers between segments. A tripping rod projects through the top and furnishes means for stopping the valve at positions intermediate between open and closed. The controller has but three positions and no resistance. In throwing the handle to the open position, for instance, it is held there without further attention until released by the tripping coil at the end of the travel of the valve, and is then brought to the off position by a strong centering spring.

## Large Base Receptacles.

Pass & Seymour, Inc., of Solvay, N. Y., have brought out two new large base receptacles, especially suited for tungsten lamps and illustrated herewith. The mechanism of the key socket is of the company's double-pole construction and the socket is,

FIG. 1.—KEY RECEPTACLE.

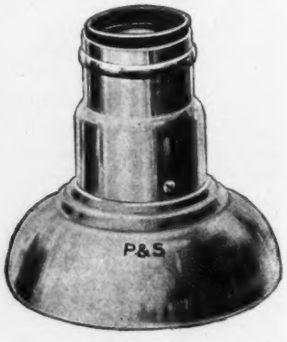



FIG. 2.—KEYLESS RECEPTACLE.

moreover, provided with an insulated mandrel. The receptacles, which are of the key and keyless types, are fitted with large recessed bases to be used in concealed work, the base being thus

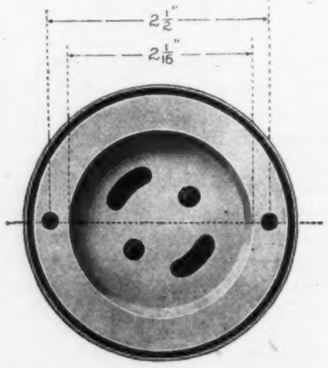


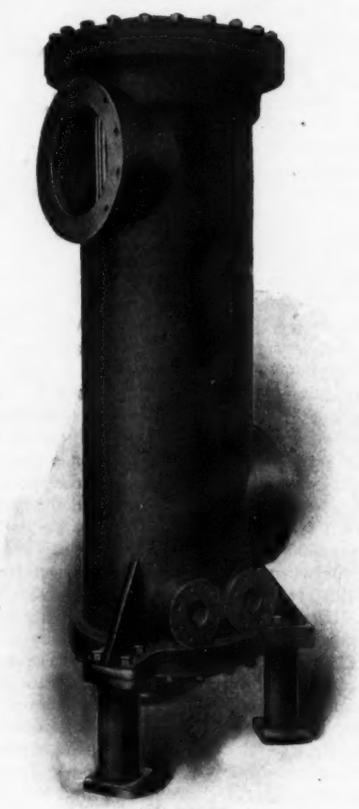

FIG. 3.—BOTTOM OF BASE.

made to take care of the end of the tubes or conduit projecting from the ceiling. The bottom of the base is 2½ in. between centers of screw holes, so the screws will properly engage the lath or joist.

## New Cochrane Open Feed-Water Heater.

The accompanying illustration shows a new heater, just introduced by the Harrison Safety Boiler Works, Philadelphia, Pa. The heater possesses all the features of the well-known Cochrane heater—that is, it heats the water by direct, actual contact with the purified steam and provides for the retention of precipitated scale-forming matter on trays and in the filter, for the escape of air and gases and for the automatic admission of sufficient new water to make up the full amount of boiler feed.

The new feature consists of a specially designed separator which is large enough in volume to purify all the steam required for heating the boiler feed water and also to handle the entire amount of steam exhausted by the engines and pumps, so that the surplus can pass directly to the heating or drying system without further purification. Upon entering the separator the steam strikes a vertically ribbed baffle plate, such as is used in the oil separators attached to other Cochrane heaters; but after passing around the baffle plate, that part of the steam required for heating the feed supply is diverted into the heater proper while the surplus steam is passed to the heating system through the "steam stack" at the top of the separator. The arrangement of parts is such that the "preference" is into the heater, so that the feed-water will be heated up to the maximum temperature before steam passes to the heating system.



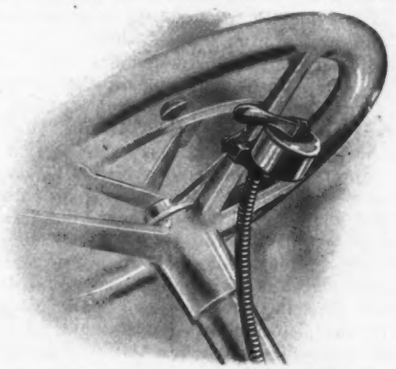
OPEN FEED-WATER HEATER.

To provide for shutting the interior of the heater off from the steam piping—that is, to make it possible to open and clean the heater while the heating system continues in operation—a cut-out valve is placed in the opening between the heater and the separator, while a similar valve is placed between the overflow opening of the heater and the steam trap, even when the heater is cut out of service. The steam cut-out valve is of cylindrical semi-rotating type and is operated from the outside by means of a suitable lever.

This large separator with valves thus takes the place, it will be noted, not only of the separator on the ordinary open feed-water heater, but of one or more gate valves and tees, and an independent separator with trap and connections. The comparison in the accompanying illustration shows the least number of extra valves, fittings, separators, traps, etc., required by an ordinary heater and receiver to perform the functions of the new surplus exhaust and cut-out valve heater. In many installations much more complicated arrangements have been installed to perform this service. For installations where there is no necessity of cutting the heater out of service while exhaust steam is being supplied to the heating system, as where a plant is running during only a part of the 24 hours, the cut-out valves can be omitted, although they are recommended even in such cases, particularly when the heater is used in connection with a heating or drying system.

## Automobile Steering-Wheel Switch.

The automobile steering-wheel switch shown herewith puts the ignition control under the right-hand of the driver and may be manipulated without the hand leaving the wheel. Four different positions are provided as follows: "Off," "Battery," "Magneto" and "Magneto and Battery together," for cars provided with two ignition systems, or may be used with a magneto or battery system alone. The device is only 1½ in. in diameter, is made entirely of brass and is dust and waterproof.



AUTOMOBILE STEERING-WHEEL SWITCH.

It is fastened by a bracket under one of the arms of the steering wheel and the controlling lever may be removed, making the car safe from interference during the absence of the driver. Only two wires are used, which are encased in flexible brass tubing and connected to the battery and magneto. No other switches are necessary. The switch may be installed by anyone, and is so simple that disarrangement cannot occur. It is made by the Connecticut Telephone & Electric Company, Meriden, Conn.

## Steel-Tape Cables.

In electrical construction work there appears to be an increasing demand for steel-tape cables to be laid underground directly in the earth without being encased in conduit. Lead-covered cable is used in various sizes, and this is encased by a spirally wound covering or protection of steel tape, the whole enclosed in a serving of jute. This type of cable is inexpensive to install and it is furnished in any length desired. A shallow, narrow trench is laid and the cable is placed within it, directly in the earth, from a cable reel. This system occupies a sort of midway position between overhead wires and the much more elaborate and expensive underground-duct system. No manholes are necessary. The steel-tape cables are particularly adapted for parks or country homes or in making service connections in cities from street mains to houses. In the last mentioned case the cable can be laid directly under the lawn, and a man with a spade can do the work of trenching, putting back the sod so that in a few days there will be no indication of the cable laid in the ground. Various sizes of cable of this type is made by the Simplex Electrical Company, of Boston.

# Industrial and Commercial News

## Commercial Intelligence.

### THE WEEK IN TRADE.

To sum up the trade conditions for the month of April, it is not going too far to assert that they were thoroughly disappointing. The net result has been a smaller retail trade than was anticipated, a hand-to-mouth jobbing business and a discouraging spring outlook for crops. The wide prevalence of unfavorable weather during the latter half of the month has done much to retard planting, and in many cases may seriously injure the coming season's yields. It has also acted as a deterrent upon all kinds of retail business. Farmers are not feeling optimistic, and are not buying with liberality. Wholesale jobbing trade for the month was better than for the same month last year, but very much smaller than had been looked for. In this circle, however, there is no lack of optimism, and it is generally believed that fall business, at least, will be entirely satisfactory. Reports of the leading industries during the past week are rather better than they have been. The low prices have evidently brought out a considerable number of orders and in the iron and steel trade, especially, there has been satisfactory buying. An announcement made during the week by the Carnegie company advancing prices on certain forms $1 per ton, on account of the fact that its shops had taken enough business to last for some months, was distinctly encouraging. It shows that one of the largest concerns in the country will be kept busy, even if the prices which it is receiving are not making the profits that were brought in by former figures. It must be a fact that other mills are in somewhat the same condition. Pig iron has also stiffened somewhat in price, and No. 2 foundry is quoted at $11.50 at Birmingham. Makers of malleable iron agricultural implements, stoves and tubes are also reasonably busy. It was also announced during the past week that the equipment companies had taken sufficient orders to keep their plants well employed during the entire summer. This is satisfactory in view of the fact that many other orders are known to be prepared and ready for placement. The building industry continues to be active, and it is evident that there will be very much more done in this line during the coming season than there was during 1908. The Chicago grain market continues to be disturbed, and prices for both wheat and corn are unusually high, apparently due to the light receipts rather than to speculative manipulation. Collections continue to be only fair, and business troubles are not unusually heavy. Failures for the week ended April 29 were 268, as against 247 for the previous week, 284 in the same week of 1908, 163 in 1907, 139 in 1906, and 193 in 1905.

### THE COPPER MARKET.

The copper market during the past week has been in a more encouraging condition than it has been at any time during the past two months. This is not due to the fact that actual sales were heavier, but to the fact that there is more evidence that the consumers are taking orders, and that there are more inquiries for copper for May and June delivery. So far, buying by local melters has not been very heavy, but it is believed that it can be only a short time until round lots must be demanded. The takings for speculative purchases abroad were not so heavy as during the latter part of March, but actual exports of copper for April will be the largest for any month since June, 1908. The shipments from Atlantic ports during April were 29,007 tons, or, in round numbers, about 65,000,000 lb. It is estimated that domestic takings will amount to something like 40,000,000 lb., and as the production is figured at about 112,000,000 lb., the addition to the surplus will be only 7,000,000 lb., or less than the addition that was credited by the figures of the Copper Producers' Association for the month of March. Prices have shown no inclination to decline during the week, and sellers, as far as can be learned, have been making no concessions. The quotations for delivery in June or any subsequent month, are very rigidly adhered to, and it is doubtful if any large quantity could be purchased at the present figures for a distant delivery. The production of copper continues at almost record figures, although the April output will be several million pounds less than that of March; in fact, it is not believed that any other month in the near future will reach the 117,058,661 lb. record that was made in March. The larger number of orders being received in the steel industry are encouraging to the copper producers, and it is generally conceded that the consumption of copper follows closely the activity in the steel trade. Quotations on the Metal Exchange May 3 were:

| | |
|---|---|
| Lake | 12⅞ @ 13 |
| Electrolytic | 12½ @ 12⅝ |
| Casting | 12⅜ @ 12½ |

The London prices May 3 were as follows:

| | Noon. £ s d | Close. £ s d |
|---|---|---|
| Standard copper, spot | 57 15 0 | 57 17 6 |
| Standard copper, futures | 58 10 0 | 58 11 3 |
| Market | Firm | Firm |
| Sales of spot | | 200 tons |
| Sales of futures | | 1,400 tons |

Extreme fluctuations for this year:

| | Highest. | Lowest. |
|---|---|---|
| Standard | ..... | ..... |
| Lake | 14.55 | 12.55 |
| Electrolytic | 14.25 | 12.12½ |
| Casting | 14.12½ | 12.00 |
| London, spot | £64 2 6 | £54 12 6 |
| London, futures | 64 17 6 | 55 10 0 |
| London, best selected | 67 15 0 | 59 0 0 |

TELEPHONE RATES REDUCED AT CLEVELAND.—The United States Telephone Company at Cleveland has announced that its schedule of rates is to be readjusted in such a manner as to make a substantial reduction to patrons of its lines. The officers of the company state that several hundred miles of new copper circuit have recently been completed in Ohio and that arrangements have been made for the construction of connecting trunk lines between the east and west, affording much greater capacity in every way, and that lower rates are to be offered to stimulate business. They deny that any plan had been made to take business from competing companies or to open any war between the Bell and the independent companies. James S. Brailey, Jr., president of the United States Telephone Company, said that he felt that his company would widen its scope of operations and extend its business by making a concession to users of the lines. The company has prepared to take care of any additional business that may come. Shortly after this announcement was made the Bell companies in Cleveland came out with special rates to various points over the country. Although they are irregular as to amount, the action of the companies indicates that competition will be close for a time. The following reductions in rates have been made by the Bell companies: Between Cleveland and Chicago, $1.25 to 75 cents; Cleveland and Cincinnati, $1.50 to $1.10; Cleveland and Detroit, 90 cents to 65 cents; Cleveland to Toledo, 60 cents to 45 cents; Cleveland and Dayton, $1.50 to $1.10. Between Pittsburgh and points named the following reductions have been made; Columbus, $1 to 75 cents; Toledo, $1.25 to 90 cents; Youngstown, 40 cents to 30 cents; Dayton, $1.50 to $1.10.

C. & C. ELECTRIC COMPANY'S SUCCESSOR.—Announcement is made that the Garwood Electric Company, a new organization, has secured the exclusive right to manufacture the dynamos, motors and other appliances which were formerly manufactured by the C. & C. Electric Company. The new company has already begun business, and it will use the same factory, with the same designs, patterns and tools, and with the same engineering staff and workmen as the old C. & C. Company. The C. & C. Company in its long career had, it is stated, put out 40,000 machines. The main office of the new organization will be at the works at Garwood, N. J., with branches at Company Building, Philadelphia. It is incorporated under the laws of New Jersey and is capitalized at $250,000.

JAPANESE ELECTRICAL MANUFACTURES.—According to a consular report the electric manufacturing industry of Japan made great strides in 1908, and was competing fairly successfully with foreign products. Generators up to 500 kw were built; also 200,000-volt, oil-immersed testing transformers and 50,000-volt to 150,000-volt insulators.

THE TARIFF ON PLATINUM.—Under the Dingley law not only crude platinum but all articles manufactured from platinum were admitted free of duty, with the exception of one or two metals which were discovered subsequent to the passage of the law, and which were not enumerated. Under the proposed new tariff law it has evidently been the intention to admit platinum and all of the metals in the platinum group free of duty, including platinum wire and scrap, but to charge 45 per cent ad valorem upon articles manufactured from platinum. The phraseology of the law is such, however, that some of the important dealers in platinum are fearful that it might be subject to a construction calling for a duty upon the metal itself. In order to have this matter cleared up Cyrus Osborn Baker, one of the most important importers and manufacturers of platinum in this country, has written a letter to a number of Senators and Representatives calling their attention to the danger of controversy if the law is adopted in its present form. Mr. Baker refers to it as an "error in phraseology, which if permitted to remain might give rise to endless controversy and litigation." He points out the wording of article No. 591, which appears under the heading of "Free List," and reads: "Iridium, osmium, palladium, rhodium and ruthenium and native combinations thereof with one another or with platinum." Also article No. 650, which reads: "Platinum, unmanufactured, or in ingots, bars, plates, sheets, wire or scrap." He then says: "It would seem that the intention is clearly to include platinum and the platinum group of metals, with all their alloys, on the free list, but the insertion of the word 'native' will certainly prove very confusing, as all metals of the group, always, when in commercial condition, contain one or more of the other metals in alloy, and by a strict interpretation might not be classified as a native combination." He also suggests that platinum sponge be included in the enumeration in article No. 650. Mr. Baker says that, as he has spent his life in the platinum manufacturing and refining industry, he believes that it is necessary to make the wording of the new act as simple and as complete as possible, and therefore suggests in place of both articles the following: "Platinum, iridium, rhodium, palladium, ruthenium, iridosmine, osmium, osmi-iridium, and any of these metals when combined or alloyed with each other. All or any of the enumerated metals or alloys, unmanufactured, or in ingots, bars, slabs, sheet, wire, sponge, or scrap." Speaking of the duty on platinum, Mr. Baker said: "If some appraiser should take it from the phraseology of the act as drawn, that platinum which contained a trace of some other metal was not a 'native combination,' and should thereupon assess a duty of 45 per cent ad valorem, it would practically destroy the platinum business in this country. As platinum is such a high-priced material, the handling of it requires a very large capital. If, for instance, we bring in a million dollars worth of platinum in a year, this would require a duty of $450,000; and, while I believe that the courts would finally hold that the collection of any such duty was not contemplated by the law, it would practically paralyze the industry to tie up that amount of money until we could get a decision. My suggestion is entirely for the purpose of making the law clear. As far as the duty is concerned, I do not particularly care one way or the other; I have made no protest against the 45 per cent ad valorem duty on manufactured articles, and I certainly did not advocate any such duty to protect the manufacturers in this country. While it is possible that under this rate of duty we might be able to push up our prices a trifle, I doubt if the protection would amount to anything to us, and it certainly would supply no revenue to the Government. I believe if the protection permitted us to advance our prices as much as 5 per cent we would have a large number of foreigners coming over here at once to manufacture platinum articles. We have been able to keep foreigners out, and to do more than 90 per cent of the business without any duty, and I do not see that the industry needs any protection." When asked about the platinum market, Mr. Baker said the demand had been a little more active, but that prices were not much advanced, ruling from $23 to $24 per oz.

CENTRAL GEORGIA POWER COMPANY.—Work upon the Central Georgia Power Company's plant, which is located at Capps and Lloyd Shoals, Ocmulgee River, in Butts County, Ga., has progressed so rapidly that it is now expected that the dam and the entire works will be completed by Jan. 1 next, and that the company will be ready to deliver its energy into Macon early in next year. This company was chartered under the general laws of Georgia in March, 1907, and undertook to develop a hydro-electric power station at the location named. The securities of the company have been placed upon the market, and it is understood that the financing has been successfully accomplished. The capital stock is $4,000,000 authorized, all of which, it is said, has been subscribed. There is to be an issue of $3,000,000 first mortgage bonds, and of this issue $2,500,000 have already been taken. The remaining $500,000 will be kept in the treasury for subsequent developments. These bonds bear 5 per cent. interest and are dated May 1, 1908. They are payable at the banking house of A. B. Leach & Company, 149 Broadway, New York. It is expected when the plant is completed that it will be able to deliver 18,000 hp. The Ocmulgee River at the site of the dam is 350 ft. wide, flowing through a hilly country. The plan contemplates a concrete and masonry dam 1452 ft. long on the crest, which will give an efficient working head of 100 ft., and will back the water up into a large reservoir, which will have a surface of 3600 acres. The water will descend through large steel feeder pipes, passing through the dam into the turbines, and thence into a tailrace. The installation so far embraces four 3000-kw turbines. Space for two additional ones of the same size is also provided in the power house. Two exciters of 250-kw direct current have also been provided. This equipment was purchased from the Westinghouse Electric & Manufacturing Company some months ago, and is now being shipped. From the transformers and switchboard the current will be carried at 60,000 volts by steel tower transmission lines to Macon and surrounding towns. Macon, which is 37 miles away, is a city of almost 60,000 population, and embraces among its industries four large cotton mills. There are many other industries in Macon which promise a good market for the energy which this company will offer for sale. The organization and ownership of the company are largely in the hands of Georgia capitalists. The president is W. Jordan Massee, who is president of the Macon Railway & Light Company. The other officials of the company are closely identified with the same traction concern.

SOUTHERN POWER COMPANY.—On April 30 the Southern Power Company of the Piedmont section on North Carolina opened its new plant at Rocky Creek on the Catawba River, which adds 40,000 hp to the capacity of the company. The company had already been delivering 55,000 hp from its plant at Great Falls which is located upon the same river. This company, which is a close corporation, belonging largely to the Duke family and other interests associated with the American Tobacco Company, is one of the most successful developments in the South. Its capitalization consists of an authorized issue of $6,000,000 preferred stock and $5,000,000 common stock. Of this issue $5,250,000 of the former and $4,000,000 of the latter have already been issued. The stock has, however, never been offered to the public, but has been taken by the interests which originated and are developing the company. It is probable that all of the preferred stock will be issued before the coming fall, as there is additional work in contemplation. The company is also building a new plant on the Broad River near Blacksburg, S. C., which is known as the Ninety-nine Island plant. It will be completed and ready for service about Jan. 1, 1910, and is expected to develop 20,000 hp. The transmission lines of the company, which are carried on steel towers, run for 110 miles, and distribute power over the entire Piedmont section. The current is carried at 100,000 volts on the main trunk line, and at a smaller voltage on branch lines. After the completion of the Blacksburg station the company has in contemplation three other plants at different locations, and expects ultimately to develop a total of 230,000 hp. The installation of the company at the Great Falls and Rocky Creek plants consists of eight 4000-kw Westinghouse generators. At the Ninety-nine Island plant there will be four or five generators of the same size and type installed. The officials of the company say that they have an ample market for all of the power they can generate, even with the increased capacity that is contemplated when the new plants are finished. Dr. Wm. Gill Wylie, of New York, is president of the company, B. N. Duke is first vice-president, and R. B. Arrington is secretary. The New York office of the company is at 111 Fifth Avenue.

ROCHESTER RAILWAY & LIGHT COMPANY.—Officials of the Rochester Railway & Light Company report that never before in the history of the company have there been received so many new contracts and applications for service. The principal increase was in residential lighting. There are many new residences being built in the city, and many of the old houses are being wired for electric lighting.

IMPROVEMENTS IN ATLANTIC CABLE SERVICE.—The plans of the Mackay Companies for improving its Atlantic cable service are very comprehensive, and if they are successful will add much to the efficiency of the lines. The company intends to connect two of its five cables directly with Newfoundland, thus giving to 40 per cent of its Atlantic mileage the benefit of a 30 per cent to 35 per cent increase in speed. It is claimed that the Newfoundland route possesses two very important advantages over any other route in that it almost equally divides the line between New York and England, making the two arms of the cable of almost equal length which permits the sending of messages at greatly increased speed. The second advantage is that the character of the ocean floor in this locality is such that thousands of dollars can be saved in repairs to cables. The Mackay Companies has also perfected an automatic relay system, by which a message passing through Newfoundland can be forwarded without the employment of an operator. It is claimed that the new route will result in a gain of at least 50 per cent over any existing system. An improvement has been shown in the earnings of the company during the last few months which is taken to mean that better times are in sight.

WORKING ON THE PENNSYLVANIA LOCOMOTIVES.—The Westinghouse Electric & Manufacturing Company has received orders at its East Pittsburgh shops to begin the construction of the first lot of electric locomotives which the Pennsylvania Railroad Company will operate in the tunnels of the New York terminals. These locomotives will be larger and more powerful than any ever heretofore constructed, each having a capacity of 5600 hp. They will be manufactured from designs made by George Gibbs, chief engineer of electric traction of the Pennsylvania Railroad Company. The mechanical parts will be made at the Altoona shops under the supervision of A. W. Gibbs and A. S. Vogt. These locomotives will be able to attain a speed of 90 miles an hour. The first lot the Westinghouse factory is to turn out consists of 24 double units of these giant locomotives, but it is understood that more will be needed soon after the terminal station is opened.

CROCKER-WHEELER COMPANY SALES.—Officials of the Crocker-Wheeler Company say that there has been recently a steady improvement in business and that inquiries are more numerous than at any time within the past 18 months. Among the large direct-current generators recently sold is one of 300 kw, 250 volts, to the Perry Fay Manufacturing Company, Elyria, Ohio, and one of 200 kw, 125 volts, to the Cleveland Provision Company, Cleveland, Ohio. There have been many sales of smaller generators ranging in size from 35 to 100 kw. A large order was placed by the Spanish-American Iron Company, Felton, Nipe Bay, Cuba, for 230-volt, direct-current motors aggregating 235 hp. Another sale of direct-current motors, which totaled 135 hp, was made to the Morgan Engineering Company, Alliance, Ohio.

NEW TUNGSTEN LAMP FACTORY.—The Heany Electric Company has recently been organized by interests connected with the General Motor Company, of Flint, Mich., for the manufacture of tungsten lamps. The company has been incorporated under the laws of Michigan with a capital stock of $150,000. A factory is being rapidly equipped in Flint which, it is promised, will be in operation within three months with a capacity of 5000 lamps per day which, it is expected, will be steadily enlarged. The filaments for these lamps will be furnished by the Heany Lamp Company, of York, Pa., with which the new company is affiliated. The general offices of the new concern will be located at Detroit.

WESTINGHOUSE MACHINE COMPANY BUSY.—The Westinghouse Machine Company has been able to record another very satisfactory month during April. During the month the company at East Pittsburgh received contracts averaging in the turbine department alone about one machine per day, some of them, like those for the San Francisco Electric Company, for 25,000 hp. Besides the turbine business, the demand for gas engines and reciprocating steam engines has also increased, while the new gas reducer, which the company recently brought out, has opened a line of inquiries that looks exceedingly promising.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction News last week and in the present issue, are announcements of proposed new plants or considerable extensions of present plants at Rifle, Col.; Fort Scott, Kan.; Albert Lea, Minn.; Taft, Tex.; Table Rock, Neb.; Toledo, Ohio; Warren, Minn.; Winnetka, Ill.; Huntington, Ind.; Berlin, Md.; Columbus, Miss.; Chicago, Ill; Brooklyn, N. Y.; Bellefonte, Pa.; Quincy, Fla.; Newark, Ohio; Trenton, N. J.; Springfield, Mass.; Henderson, N. C.; Springfield, Ohio; Indianapolis, Ind.; Gouverneur, N. Y.; Boston, Mass.; Virginia, Minn.; Grand Forks, N. D.

BIG CONTRACT FOR UNDERGROUND CABLE.—The Standard Underground Cable Company, of Pittsburgh, has been awarded the contract for all of the high-tension lead enclosed cables that are to be used in connection with the new Pennsylvania Railroad terminal in New York City. These cables will extend from Long Island City to the Hackensack Meadows under both rivers and the Borough of Manhattan. The contract is one of the largest ever placed for underground cables and will amount to several hundred thousand feet. The contract calls for cables which are designed to carry 11,000 volts.

ALBEMARLE (N. C.) DEVELOPMENT COMPANY.—The prospects for an early completion of the electrical development on the Yadkin River, near Albemarle, are stated to be encouraging. A contract has been let to L. A. Moody for the erection of a stone and concrete dam across the river. This dam will be 160 ft. in length and will be 10 ft. high and 10 ft. at the base. The development is being engineered by the Albemarle Development Company, and according to J. C. Masters, one of the promoters, will represent an expenditure of $1,000,000.

ELEVATED RAILROAD TRAFFIC IN CHICAGO.—Daily average traffic on the South Side elevated road in Chicago in April, 1909, was 116,205 passengers, a decrease of 1.43 per cent compared with the corresponding figures for April, 1908. The North Side elevated company's average for April, 1909, was 117,574 passengers, an increase of 13.52 per cent compared with the corresponding month of last year. The two West Side elevated roads have not made public the figures of their daily traffic for April.

TO COMPLETE BLEWITT-FALLY HYDRO-ELECTRIC PLANT.—United States Judge J. C. Pritchard has issued an order returnable in chambers in Richmond, Va., May 8, to all parties interested to appear before him to show cause why the property of the Rockingham Power Company should not be sold under order of the court. It is anticipated that the court will order the sale, and that the development will be prosecuted on a large scale.

WIRELESS TELEPHONE RIGHTS.—Announcement has been made that the Radio Telephone Company, of New York, of which Lee De Forest is engineer, has acquired by purchase the exclusive license to manufacture, use and sell wireless telephone apparatus in the United States under the numerous patents owned by the Stone Telegraph & Telephone Company.

BIDS FOR ELECTRIC ELEVATOR.—Sealed proposals for an electric freight elevator, to be installed for the United States Marine Corps in Philadelphia, will be received until May 7 by Colonel F. L. Denny, U. S. M. C., U. S. Marine Corps Quartermaster Department, Washington, D. C.

NEW HAVEN TO CHANGE ITS STREET LAMPS.—The United Illuminating Company, of New Haven, has determined to put in for street lighting purposes 800 G. E. magnetite arc lamps. These are to replace open arc lamps heretofore in use.

## *Financial Intelligence.*

### THE WEEK IN WALL STREET.

The market in Wall Street during the past week has differed very little from the market of the past month. Stocks have as a general rule been strong, but advances in prices have been very insignificant, and in some instances there have been losses recorded. Trading has not been particularly active, averaging about 600,000 shares per day, and business has been very largely professional. On every advance in prices there have been evidences of profit taking, and on every reaction of prices there has been enough buying to furnish ample support. These things indicate that the market is practically one of speculative traders, who are taking narrow profits and making quick turns. The decision of the United States Supreme Court, on May 3, on

the commodities clause of the Hepburn law, was taken as a distinct victory for the coal owning roads and resulted in an immediate advance in Reading, and the other properties most affected. Beyond this there has been during the week no distinctive movement in any particular stocks. The stocks of the United States Steel Corporation have continued to be strong, and the common has shown a particular disposition to advance. This may be regarded as remarkable, in view of the fact that the report of the last quarter of the company was unfavorable as far as the quantity of business is concerned, and that it is known that the next quarter will reflect even smaller profits, although the business may be larger. The general opinion, however, is that industry must speedily awaken, and Wall Street traders are perfectly willing, when money is as cheap as it is at the present time, to anticipate the good times which are expected in the future. Copper stocks have kept remarkably strong in price, in view of the adverse statistical report from the copper market and the well-known scarcity of buying orders from domestic consumers. Traction stocks in Wall Street have been comparatively stronger than they were a few weeks ago, and Brooklyn Rapid Transit especially has shown its resistance to pressure by failure to record any considerable decline in the face of some adverse legislation at Albany. The disturbances in Turkey and the continuation of the tariff debate are both deterrent influences to an important advance, but they really seem to have but small effect in the Street. Bonds continue to be extremely strong, and any sort of an issue is well taken. In fact, there is no industry and no railroad that is hesitating about making improvements or extensions on account of its inability to place bonds. The big interests are simply waiting for the actual return of business to make extensions. Money continues to be easy, and the banks are overloaded with cash. Quotations May 3 were call 1¾ @ 2 per cent, and 90-day paper 2½ @ 2¾ per cent. The quotations in the table are those of the close May 3.

NEW YORK.

| | Apr. 26. | May 3. | Shares Sold. | | Apr. 26. | May 3. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| All.-Ch. | 15½ | 16⅜ | 3,065 | Int.-Met., pfd. | 44¾ | 47 | 62,400 |
| All.-Ch., pfd. | 49⅛ | 50½ | 7,300 | Mackay Cos. | 78½* | 78½ | 1,150 |
| Amal. Cop. | 76⅛ | 77⅜ | 97,405 | Mackay Cos.,pfd. | 73½* | 73¼ | 2,000 |
| Am. D. T. | 29* | 29* | ——— | Manhattan Elev. | 144¾* | 143½* | 1,295 |
| Am. Loc. | 54½ | 56 | 10,020 | Met. St. Ry. | 26 | 27½ | 200 |
| Am. Loc., pfd. | 114 | 115 | 820 | N.Y. & N.J.Tel. | 124* | 125* | 100 |
| Am. Tel. & Cbl. | 76* | 76* | ——— | Steel, com. | 53 | 56⅜ | 435,942 |
| Am. T. & T. | 139¾ | 141 | 42,016 | Steel, pfd. | 114¾ | 116¾ | 12,050 |
| B. R. T. | 77½ | 78⅝ | 95,450 | W. U. T. | 68½ | 75¼ | 26,450 |
| Gen. Elec. | 158¼ | 160 | 3,600 | West'h., com. | 81½* | 83¼ | 9,450 |
| Int.-Met., com. | 15⅜ | 17⅛ | 43,591 | West'h., pfd. | 119* | 120* | 600 |

PHILADELPHIA.

| | Apr. 26. | May 3. | Shares Sold. | | Apr. 26. | May 3. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| Am. Rys. | 45½ | 46 | ——— | Phila. Elec. | 12 | 12 | ——— |
| Elec. Co. of A. | 12¼* | 12⅜ | ——— | Phila. R. T. | 35⅜ | 35½ | ——— |
| Elec. Stor. B'ty. | 45¾* | 45½ | ——— | Phila. Traction. | 93* | 94 | ——— |
| E. S. B'ty, pfd. | 49* | 49* | ——— | Union Traction. | 57¼ | 58⅛ | ——— |

CHICAGO.

| | Apr. 26. | May 3. | Shares Sold. | | Apr. 26. | May 3. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| Chi. City Ry. | 180* | 180* | ——— | Chi. Tel. Co. | 133* | 132½ | ——— |
| Chi. Rys., Ser.1. | 110* | 109½* | ——— | Met. El., com. | 19 | 19* | ——— |
| Chi. Rys., Ser.2. | 39 | 38½* | ——— | Nat'nal Carbon. | 84 | 85 | ——— |
| Com. Edison. | 114 | 114½ | ——— | Nat. Carb., pfd. | 120* | 120* | ——— |
| Chi. Subways. | 25½ | 25½* | ——— | | | | |

BOSTON.

| | Apr. 26. | May 3. | Shares Sold. | | Apr. 26. | May 3. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| Am. Tel. & Tel. | 139 | 141 | ——— | Mex. Tel. | 2¾* | 3 | ——— |
| Cum. Tel. | 131 | 131* | ——— | Mex. Tel., pfd. | 6* | 5⅞* | ——— |
| Edison El. Ill. | 258 | 253* | ——— | N. E. Tel. | 132 | 132½ | ——— |
| Gen. Elec. | 158 | 158 | ——— | W. Tel. & Tel. | 9 | 11¾ | ——— |
| Mass. Elec. Ry. | 14¼* | 14½ | ——— | W. T. & T., pfd | 83 | 85 | ——— |
| Mass. E. R., pfd | 72 | 72 | ——— | | | | |

*Last price quoted.
Shares sold are for week April 26 to May 1.

## DIVIDENDS.

Consolidated Gas Company, New York, quarterly, 1 per cent. payable May 18.

Electric Properties Company, New York, preferred, quarterly, 1½ per cent, payable May 19.

Otis Company, semi-annual, 5 per cent, payable May 1.

Tampa (Fla.) Electric Company, semi-annual, 3½ per cent, payable May 15.

NEW YORK & ONTARIO POWER COMPANY'S BOND AND STOCK AUTHORIZATION.—The New York Public Service Commission of the Second District has just issued the full text of its decision of Jan. 4, 1909, authorizing the New York & Ontario Power Company to issue $600,000 in stock and $1,850,000 in bonds in order to take over all rights and property connected with a proposed 30,000-hp hydro-electric development at Waddington, on the St. Lawrence River. It is stipulated that the stock shall be sold for cash only at full par value and that the bonds shall not be sold for less than 81 per cent of their par value—the applicants having stated they have succeeded in interesting capital on these terms. Only 17,400 hp will be developed initially, the estimated cost for this capacity being $2,100,000 and for the estimated gross annual charges $180,000. Evidence submitted tended to show that there is a reasonably assured market within the immediate vicinity of Waddington for the full output of the proposed plant.

BOSTON EDISON PURCHASES APPROVED.—A special meeting of the stockholders of the Edison Electric Illuminating Company, of Boston, was held April 30, for the purpose of approving the purchase of the location and property of several smaller companies. The stockholders voted to purchase the Chelsea Gas Light Company for $350,000; the Boston Consolidated Gas Company at $1,300,000; the Newton & Watertown Gas Light Company for $500,000; the Waltham Gas Light Company for $600,000, and the Lexington Gas & Electric Company for about $120,000. This requires a total of $2,870,000, and it is the intention of the directors to finance the deal temporarily, and in a year or so to increase the capital stock to take up the obligations which will be issued at this time. Another meeting will be held May 6 to hear reports from the smaller companies and from the Massachusetts Gas Commission.

TELEPHONE SECURITIES PRAISED AS AN INVESTMENT.—Edward B. Smith & Company, New York, and Thomas A. Biddle & Company, Philadelphia, have published a pamphlet giving the results of their study of the plants of the American Telephone & Telegraph Company from the standpoint of an investment proposition. The pamphlet sets forth the many advantages possessed by the securities of this company, specifying that they are yielding an excellent return, with prospect of advancement; that the status of the business in the world is fixed; that the securities represent dollar for dollar in expenditure; that the business represents one that is universal in use, and that it suffered less than almost any other business during the time of depression, and that it has always a ready market value either for sale or as collateral.

HUDSON RIVER WATER POWER COMPANY.—The receivers of the Hudson River Water Power Company have deposited with the Trust Company of America $125,000 with which to pay the semi-annual interest due last November on the company's $1,938,000, 5 per cent gold bonds. It is said that under the receivers the earnings have so improved that it is not only able to pay the November interest, but it is expected that in a short time the May 1 interest will be forthcoming. This is one of the seven subsidiary and allied companies of the Hudson River Electric Power Company, for which receivers were appointed last fall, after the failure of E. H. Gay & Company.

CINCINNATI TRACTION TERMINALS.—Cincinnati traction interests have recently formulated plans to control the traction terminal facilities in that city. These plans have been submitted to the various civic bodies asking for their support, and it is not believed that there will be any difficulty in securing the franchises desired. It is claimed that if the plan is worked out, it will mean much to the business interests of the city and the great interurban traffic which is now considerably scattered will be concentrated at a convenient point.

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY.—The annual report of the New England Telephone & Telegraph Company shows that 16,737 stations were added during the past year, making a total of 241,598 in service December 31, when the report was made. Including sub-license stations the total number of stations was 304,986. The balance sheet of the company showed that the appraisal value of the entire property was $46,540,819, and that the total par value of the securities held is $38,939,850.

CALIFORNIA GAS & ELECTRIC BONDS.—J. P. Morgan & Company, the First National Bank and the National City Bank of New York have recently purchased $5,000,000 of unifying and refunding 4 per cent bonds of the California Gas & Electric Corporation. Lee, Higginson & Company, of Boston, are also associated with the purchase, and it is probable that the securities will shortly be offered to the public.

HUDSON RIVER TELEPHONE COMPANY SOLD.—The stockholders of the Hudson River Telephone Company have approved a plan for the sale of their property to the Central New York Telephone Company. The present Hudson River stockholders will receive $66 per share for their shares.

COMPETITION IN NEW YORK TELEPHONE SERVICE.—The Public Service Telephone Company, which has recently been incorporated at Albany, and which is backed by the Longacre Electric Light & Power Company, of New York City, it is stated will soon enter the telephone business in New York in competition with the New York Telephone Company. The organization of the new concern has been perfected by the election of John M. Shaw as president, and John A. L. Campbell as secretary. The board of directors includes George S. Graham, Clarence Simpson, R. Conklin, A. J. Wheeler, Jr., and Russell Robbins. The capital stock of the company is $10,000,000, one-half common and one-half preferred, and there is an authorized issue of $25,000,000 of bonds. Mr. Shaw, president of the company, makes the following statement as to its purpose: "The organization proposes to do a general telephone business in the city of New York, and it has taken a lease from the Longacre Electric Light & Power Company for a term of 999 years of a franchise which that company has, to do a telephone business. This franchise has been fought out through the courts, and finally settled in favor of the Longacre company. The franchise rights that we have leased are sufficient to enable our company to do business without any additional power conferred upon it by the city, and our company is willing to enter into any agreement with the city which is reasonable about the division of the receipts which should be paid to the municipality." It does not seem that this company is in any way connected with the Great Eastern Telephone Company, which recently increased its capital stock from $1,000,000 to $50,000,000, and which promises to enter the field in New York State. D. A. Reynolds, president of this latter company, says that his concern has ample franchises and capital to serve the entire city of New York, and that it will be connected with the affiliated Independent telephone lines throughout this State and the West. He is not, however, ready as yet to make any definite statement as to the plans of the company.

PREPARING TO FINANCE THE STANISLAUS DEAL.—Ernst Thalmann, president of the United Railways Investment Company, has sent a letter to the stockholders pointing out to them the important matters that will be taken up at the annual meeting to be held May 17. Chief of these is, of course, preparing the way for the purchase of the Stanislaus Electric Power Company's properties. The stockholders will be asked to authorize an increase in the capital stock of the Investment company of $10,000,000 of preferred stock, and to sanction the sale of $10,000,000 of the common stock of the United Railroads of San Francisco, which is now held in the treasury. This latter stock will be transferred eventually to the corporation to be organized, and controlled through ownership, for the purpose of taking over the Stanislaus property. The issue of $1,000,000 of the preferred stock and $1,000,000 of the new common is all that is contemplated at the present time, the balance to be held in the treasury for use when the deal is completed. In speaking of the necessity for taking over the Stanislaus plants, President Thalmann says that for some time past the operations of the United Railroads company have been hampered by lack of adequate electric power under its own control, and he believes that the control of the Stanislaus company, which includes the control of the Tuolumne Water Power Company, will furnish all the energy that the railways require.

AMERICAN LIGHT & TRACTION COMPANY.—The gains being made in the earnings of the operating companies that are controlled by the American Light & Traction Company show that the profits for the current year will run far ahead of the dividend requirements, even in the face of the recent increase in the rate. The statement for the first quarter of 1909 shows that there is an increase of $175,000 in the total earnings paid in by the 12 subsidiary companies over the amount paid in in 1908. At this rate, estimating the three succeeding quarters to be the same, the parent company would earn in 1909 a total of $3,300,000, or something like 32 per cent on the old common stock, after paying 6 per cent on the preferred. There will be put out on Nov. 1 a stock dividend amounting to $752,000, and this new stock will receive its first dividend in the subsequent February.

INTERNATIONAL SMELTING & REFINING COMPANY.—Although the original $10,000,000 of capital stock of the International Smelting & Refining Company has barely been paid in, the company has already accumulated a surplus of $300,000 from the operations of the Raritan Refining Works and the cash on hand amounts to $3,000,000. A portion of this surplus will be used to complete the new smelter in Utah, but it is estimated that there will be sufficient funds left to pay a dividend in June of 6 or 7 per cent on the capital stock. As soon as John D. Ryan returns from the West, which will be early in May, some announcement is expected concerning the company's plans for constructing new smelting and refining plants throughout the country.

LACLEDE GAS LIGHT COMPANY SOLD.—The negotiations which have been pending for some time, and by which the North American Company will sell to the American Light & Traction Company the Laclede Gas Light Company of St. Louis, have been practically completed, only the formal ratification by the stockholders of the companies remaining. The American Light & Traction Company will pay 93½ for the common stock of the Laclede company, but will buy none of the $2,500,000 preferred, which is owned by outside parties. The North American Company will receive between $7,000,000 and $8,000,000, and payment will be made partly in cash, partly in notes and partly in preferred and common shares of the American Light & Traction Company.

WALTHAM GAS COMPANY LIQUIDATED.—At a special meeting last week of the stockholders of the Waltham (Mass.) Gas Company it was decided to sell the electric business of the company to the Edison Electric Illuminating Company of Boston, for $600,000 and the gas business to the Newton & Watertown Gas & Electric Company for $500,000. As practically all of the capital stock of the Waltham company is owned by the Boston Suburban Electric Companies, it is this company that will profit by the transaction. Of the $1,100,000 received, $350,000 will be used to cancel notes outstanding, and the balance will be turned over to the Suburban company to take up the $324,700 capital stock that has been issued.

DEVELOPMENT AT HICKORY, N. C.—The construction of the proposed Hickory, N. C., railway will not be ready for consideration until the Water-Power Electric Company, of Hickory, has been financed for construction and is quite ready for operation. This proposition is now in shape and ready for intelligent presentation. Any one interested in that line can address the president, Colonel M. E. Thornton, at Hickory, N. C. The stock issue is $500,000, of which $240,000 is in the treasury, and the bonds will be $650,000, bearing 6 per cent interest, payable semi-annually. It is hoped to make a deal at once for the bonds, or a loan on a majority of the stock at 6 per cent for 12 months.

HAVANA TELEPHONE SYSTEM.—President Gomez, of the Cuban Republic, has issued a decree accepting the renunciation of its franchise by the Havana Telephone Company, and receiving, according to the terms of the contract, all the properties of the company which at the expiration of the contract revert to the State. The company is given a lease on the property for 18 years, under which it will pay a yearly rental of $24,375 for the first two years, and $150,000 yearly for the remainder of the period. The company expects to establish a thorough underground system which it is estimated will cost about $1,500,000.

CHICAGO-MILWAUKEE ELECTRIC COMPANY.—There are still several parties negotiating for the purchase of the Chicago-Milwaukee Electric Company. Representatives of a Toronto syndicate are in Chicago looking over the property, and may make an offer. George Mindeman, a Kansas City capitalist, is also on the ground and is negotiating for the purchase. Mr. Mindeman says that if the interests he represents secure the road it will be extended into other parts of Illinois and also in Wisconsin.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.—The March statement of the Cumberland Telephone & Telegraph Company shows that it is sharing in the general prosperity which seems to be the rule with all licensees of the Bell system. The net receipts for the month were $185,045, which is at the rate of 11.28 per cent a year on the capital stock. Expenses are now averaging but 64 per cent of the gross receipts.

TRI-CITY RAILWAY & LIGHT COMPANY.—The report of the Tri-City Railway & Light Company, of Davenport, Iowa, for the quarter which ended March 31, shows gross earnings of $489,836 and net earnings of $206,886, which is a considerable gain over the same period last year. The surplus after paying dividends on the preferred stock was $38,904.

NORTH CAROLINA PUBLIC SERVICE COMPANY.—A new company recently organized under the laws of North Carolina, called the North Carolina Public Service Company, of Greensboro, will take over all the property and rights of the Greensboro Electric Company. This property includes the gas plant and distributing system, the electric light and power station and the transmission lines and the electric street railway covering the principal streets and operating 11½ miles of track. The new company has made a contract with the Southern Power Company for energy and the cost of fuel is so high it is not economical to operate the steam plant now in Greensboro. The capitalization of the North Carolina Public Service Company is $3,500,000 capital stock authorized and $3,500,000 5 per cent bonds. It is proposed to improve and extend the properties at once and to equip an interurban line to High Point. L. H. Hale is president, and Bird S. Coler, of New York, vice-president. The fiscal agents of the company are W. N. Coler & Company, 43 Cedar Street, New York.

RAILWAY SECURITIES SOLD AT AUCTION.—At the last weekly sale of securities at auction in New York, several large blocks of those issued by the Virginia Passenger & Power Company were disposed of. This is the company in which Frank J. Gould held a large interest and which has been in the hands of a receiver for the past five years. The sale included $648,000 of the consolidated 5 per cent bonds, class A, at 60; $475,000 of the same bonds, class C, at 90 and interest; 2,567 shares of the preferred stock, at $300 for the lot, and 856 shares of the common stock, at $100 for the lot. There were also sold $50,000 of the first mortgage bonds of the South Side Railway & Development Company, a subsidiary, at 90 and interest, and 6000 shares of the stock of the Richmond & Petersburg Electric Railway Company, another of the subsidiary concerns, at 25, and $500,000 of the latter's first mortgage 5 per cent bonds at 100 and interest.

BLACKSTONE VALLEY CONSOLIDATION DEFEATED.—The legislature of Rhode Island, on April 30, voted to indefinitely postpone the bill providing for the incorporation of the Blackstone Valley Gas & Electric Company. This was a bill through which Stone & Webster, owners of a majority of the stock in the Pawtucket Gas Company, Pawtucket Electric Company, Woonsocket Gas Company and Woonsocket Electric Machine & Power Company, sought to consolidate the holdings in one concern. The new company was also to have the right to purchase the Providence Gas Company and the Narragansett Electric Lighting Company. The Blackstone Valley Gas & Electric Company is already incorporated under the laws of Maine, but its subsidiary companies are doing business separately.

WASHINGTON WATER POWER COMPANY EARNINGS.—The gross earnings of the Washington Water Power Company for 1908 show an increase of $343,124 over the previous year, and are almost exactly double those of 1905. There has been an increase of 25 per cent in the number of incandescent lamps used, and everything else in the line of lighting has increased proportionately. The number of passengers carried on the traction system during the year was 19,520,942, an increase of about $2,300,000. Much of the success of this company is attributed to the blanket charter under which it operates. This confers the right to own and operate mills, canals, electric light and power plants, street railways, parks, dance halls, baths and almost anything else for which energy could be used.

ORGANIZATION OF A GREAT COPPER TRUST.—Financial circles during the past week have been regaled with many rumors to the effect that a great copper trust, representing all of the most prominent producing and consuming interests of the country, was in the process of formation. There does not seem to be any definite authority for such a story, further than the fact that there was recently a dinner at which representatives of these interests were present, and it was stated that some of the speakers referred to the advisability of an agreement that would regulate prices. It was suggested that an organization such as the Steel Corporation might be formed in the copper industry. In view of the widely diverging interests of the copper producers such an organization would be very difficult.

METROPOLITAN STREET RAILWAY SALE.—There will apparently be no litigation to interfere with the sale of the property of the Metropolitan Street Railway, as ordered on June 1. The property will be offered as an entirety at the court house door on that day, and the instructions of the court are that no bidder shall be recognized until he has deposited $100,000, in cash or a certified check, with the commissioner. It is now presumed that the Interborough Company has made arrangements to protect its interests in the property. No report has as yet been made by the reorganization committee or by Stone & Webster, who were employed to draft plans for the reorganization.

CHANGES IN U. S. TELEPHONE COMPANY'S BOARD.—Frank A. Davis, president of the Columbus Citizens' Telephone Company, and D. J. Cable, of Lima, Ohio, have been elected members of the board of directors of the United States Telephone Company, of Cleveland, H. B. Taylor and W. L. Carey having resigned to make room for them. The smaller companies of the State and the Ohio Independent Telephone Association will both have representation on the board through this action. A closer connection of this kind was desired both by the officers of the company and the members of the State organization, and it is believed that it will result in benefit to both.

ELECTRIC MERGER IN TOKIO.—News has just been received from Tokio, Japan, of the merger of the American General Electric Company, Shibaura Engineering Works and the Tokio Electric Company. The American General Electric is a large shareholder in the Tokio Electric Company, and the three concerns are principally in the business of manufacturing incandescent lamps.

MEXICAN TELEGRAPH COMPANY DIVIDEND.—The directors of the Mexican Telegraph Company have decided to issue 7,500 shares of new capital stock on June 1, to be distributed as a 25 per cent stock dividend to shareholders of record May 15. This new stock will participate in the regular July cash dividend.

## REPORTS OF EARNINGS.

| | Gross earnings. | Expenses. | Net earnings. | Charges. | Surplus. |
|---|---|---|---|---|---|
| Aurora, Elgin & Chicago Railroad Company: | | | | | |
| March, 1909 | $101,972 | $60,349 | $41,622 | $28,764 | $12,853 |
| March, 1908 | 95,773 | 56,652 | 39,121 | 27,770 | 11,351 |
| Dallas (Tex.) Electric Corporation: | | | | | |
| February, 1909 | 94,588 | 57,953 | 36,636 | 25,439 | 7,863 |
| February, 1908 | 84,650 | 57,725 | 26,926 | 25,849 | 2,257 |
| Detroit United Railway Company: | | | | | |
| March, 1909 | 589,287 | 360,742 | 228,545 | 152,090 | 88,442 |
| March, 1908 | 529,236 | 338,294 | 190,942 | 134,714 | 60,780 |
| Electric Light & Power Company, of Abington and Rockland: | | | | | |
| February, 1909 | 5,570 | 3,470 | 2,100 | 327 | 1,772 |
| February, 1908 | 5,037 | 2,820 | 2,216 | 223 | 1,772 |
| General Electric Company: | | | | | |
| Year ended Jan. 31, 1909 | 47,168,469 | 42,366,217 | 4,366,252 | 5,214,026 | *411,774 |
| Year ended Jan. 31, 1908 | 72,484,988 | 65,898,335 | 6,586,653 | 5,183,614 | 1,403,039 |
| Lake Shore Electric Railway System: | | | | | |
| March, 1909 | 76,679 | 47,235 | 29,443 | 34,324 | 4,881 |
| March, 1908 | 73,144 | 46,997 | 26,146 | 31,103 | 4,956 |
| Manufacturers' Light & Heat Company, of Pittsburgh: | | | | | |
| March, 1909 | 1,539,221 | 551,212 | 1,088,009 | 245,287 | 842,722 |
| March, 1908 | 1,245,502 | 514,041 | 910,461 | 331,875 | 578,603 |
| Massachusetts Electric Company: | | | | | |
| Quarter ending March 31, 1909 | 1,613,034 | 1,238,264 | 374,770 | 450,698 | *75,928 |
| Quarter ending March 31, 1908 | 1,552,171 | 1,127,120 | 425,051 | 464,316 | *39,265 |
| Twin City Rapid Transit Company, Minneapolis: | | | | | |
| March, 1909 | 541,936 | 279,307 | 262,629 | 138,963 | 123,666 |
| March, 1908 | 484,622 | 252,824 | 231,798 | 123,386 | 108,412 |
| United Gas Improvement Company, Philadelphia: | | | | | |
| Year 1908 | 7,216,911 | 890,203 | 6,326,706 | 3,670,788 | 1,977,419 |
| Year 1907 | 6,830,583 | 829,437 | 6,001,146 | 3,663,136 | 2,338,010 |

*Deficit.

# GENERAL NEWS

## Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has been granted a franchise to extend its North Highlands line a distance of about one and one-half miles.

PARKER, ARIZ.—Two franchises have been granted by the Board of Supervisors. One to T. M. Drennan, J. L. Curtis, Fred T. Bragonier, C. F. Shade and Le Roy Anderson for an electric power plant for a term of 25 years. The franchise calls for rights in Yuma County, especially in the town site of Parker. A telephone franchise was given to Henry Mitchell, the line to begin at the boundary of Maricopa County adjacent to the right-of-way of the Arizona & California Railroad, thence to Parker; also from Salome to Harqueholo.

LITTLE ROCK, ARK.—The contract for the construction of the power plant in connection with the union depot has been awarded to the Westinghouse, Church, Kerr & Company, New York, N. Y. The cost of the plant is estimated at $60,000 and is to be completed by Aug. 1. W. E. Strolbrand is engineer in charge of the work.

EUREKA, CAL.—It is reported that the Snow Mountain Power Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a 4000-hp turbine to be direct connected to a three-phase, 60-cycle, 2300-volt alternating current generator and a 150-hp exciter set to be installed in its plant in this city.

MODESTO, CAL.—The Modesto Interurban Railway Company has awarded contracts for the grading of its proposed railway. The motive power has not yet been decided upon. T. K. Beard, of Modesto, is president, and W. A. Cooper, 1370 Franklin Street, Oakland, Cal., chief engineer.

MONTEREY, CAL.—Arrangements are being made by the Monterey County Gas & Electric Company for extensions and improvements to its system, which will include the installation of two new boilers and the construction of a transmission line to the Salinas; also to install a gas plant. The cost of the entire work is estimated at about $70,000.

NAPA, CAL.—Preliminary arrangements are being made by the San Francisco, Vallejo & Napa Railroad Company for extending its railway to Calistoga.

NEEDLES, CAL.—The Board of Supervisors has awarded B. L. Vaughn a franchise for the desert telephone line, for which he paid $50.

OAKLAND, CAL.—The Council is reported to be considering the question of appropriating $20,000 for the erection of a power house at Magnolia and Twenty-fourth streets.

OAKLAND, CAL.—The Great Western Electric Power Company has awarded the contract for the construction of its substation on Matthew Street in Oakland to the Thompson Starrett Construction Company, of San Francisco, for $45,000.

ONTARIO, CAL.—Rights of way are being secured by the Ontario & San Antonio Heights Railway Company for its proposed electric railway between Uplands and Claremont, a distance of about six miles. The cost of the railway is estimated at from $150,000 to $175,000.

PASADENA, CAL.—Arrangements are being made to replace the present power house at Mt. Wilson with a concrete structure. Improvements will also be made in the equipment of the plant.

SACRAMENTO, CAL.—The City Trustees have granted the Central California Traction Company, of San Francisco, a franchise which provides that the Northern Electric Railway, the Vallejo & Northern Railway and two more railways shall be permitted to use the tracks the company proposes to lay on X and Eighth streets.

SAN BERNARDINO, CAL.—The directors of the Lytle Creek Power Company have decided to increase the output of the plant and make extensive extensions to the service in the residence section of this city. A bond issue to the amount of $300,000 will be voted to cover the cost of the work.

SAN FRANCISCO, CAL.—Plans are being prepared by Joseph David Atkins, of the Department of Public Buildings, Treasury Department, Washington, D. C., for the installation of a new auxiliary power plant in the San Francisco mint. The cost of the machinery is estimated at $40,000.

SAN JOSE, CAL.—The contract for the installation of power plant at the State Normal School at San Jose has been awarded to Rickon-Ehrhart Company, 1859 Geary Street, San Francisco, Cal., for $25,676.

SANTA ANA, CAL.—Negotiations have been completed for the construction of an electric railway between Santa Ana and Huntington Beach. The railway will be built by the Pacific Electric Railway Company, of Los Angeles.

SONORA, CAL.—Arrangements are being made to install new machinery in the Empire Mill. The electric plant will be removed to Cold Spring and an entirely new plant installed in the Empire Mill. G. W. Birmingham has charge of the work.

BOULDER, COL.—At the recent election the citizens voted in favor of the proposition to issue $40,000 in bonds for the construction of an electric light plant.

BLOOMFIELD, CONN.—At a special town meeting held recently the citizens voted to authorize the Selectmen to enter into a contract with the Hartford Electric Light Company for a term of five years at a cost not to exceed $600 per year. The company submitted a proposition offering to furnish 50 lamps of 60 cp at $18 per lamp per year.

GROTON, CONN.—The contract for furnishing electricity for lighting the new barracks at the navy yard has been awarded to the Groton municipal electric light plant. The transmission line will be extended from the Odd Fellows' Home at Fairview to the navy yard at an approximate cost of $1,000. The contract calls for about 200 lamps of 16 cp. It is expected that many of the private residences along the route will install electric lamps.

HARTFORD, CONN.—The Senate has passed the bill authorizing the Union Light & Power Company to do business in Avon, Canton and Burlington.

HAVANA, CUBA.—The Havana Telephone Company, whose contract with the Government expires next year, has surrendered its rights under this contract and has obtained a lease from the Government for 18 years, the company to pay $24,375 yearly for the first two years and $150,000 for the remainder of the contract. Messrs. Jarvis & Conklin are at the head of the company.

WILMINGTON, DEL.—The Wilmington Light & Telephone Company has been awarded the contract by the Board of Education to furnish electricity for lamps and motors for the various school buildings throughout the city.

WASHINGTON, D. C.—Work has commenced on the construction of the proposed electric railway of the Washington, Spa Springs & Gretta Railroad Company. The railway will extend from Washington to Bladensburg, Riverdale and Berwyn Heights, a distance of 10½ miles. S. S. Yoder, of Washington, D. C., is president, and C. D. Eldridge, electrical engineer.

QUINCY, FLA.—The citizens on April 27 voted to issue $9,000 in bonds for the construction of an electric light plant. Bids for construction of the plant will be received soon. George H. Palmer, of Quincy, is engineer.

TAMPA, FLA.—The Tampa Sulphur Springs Traction Company expects to place contracts within two weeks for the construction of three miles of track.

ATLANTA, GA.—The Georgia Railway & Electric Company has filed a mortgage of $20,000,000 in Fulton County in favor of the American Trust Company, of Boston, Mass., covering an issue of refunding bonds and providing funds for large improvements shortly. The State Railroad Commission has authorized the company to issue $1,200,000 in improvement bonds. The remainder will be used for improvements from time to time as the need may arise.

DOUGLASVILLE, GA.—The issue of $10,000 in bonds for a municipal electric lighting plant has been declared valid and has been approved in the circuit courts of Georgia. The plant will be completed as soon as possible.

ELLIJAY, GA.—The City Council is considering the question of issuing bonds for the construction of an electric light plant and water-works system, which will be submitted to the vote of the people.

FITZGERALD, GA.—Arrangements are being made by the Fitzgerald & Ocilla Electric Railway & Power Company for the construction of a power plant on Lake Beatrice to furnish electricity for lamps and for operating a 12-mile railway. C. A. Holtzendorf is general manager.

WAYCROSS, GA.—The Railroad Commission has adopted the report of Roland B. Hall, Jr., electrical engineer, sent by the commission to make investigations in regard to the differences which have arisen between the people and the Waycross Electric Light & Power Company, which will require the company to make improvements to its plant and service suggested in the report of Mr. Hall. The commission has declined to order any reduction in the rates charged by the company, as the report showed that the cost to the company for production of electricity at the switchboard was 6.75 cents per kw-hour, and that the average price received, after considering the loss in transmisssion, is about 7.04 cents. The present price of electricity to small consumers is 15 cents per kw-hour, running down to 7½ cents per kw-hour for electricity for motors.

HONOLULU, HAWAII.—It is reported that the Automatic Telephone Company has purchased the controlling interest of the Bell Telephone Company in Honolulu.

KELLOGG, IDAHO.—The Washington Water Power Company, of Spokane, Wash., has been granted a franchise to erect a transmission line through Kellogg.

VOLLMER, IDAHO.—It is reported that the Trustees have taken over the local electric light plant, and will expend about $4,000 for improvements.

CHICAGO, ILL.—Bids will be received by the city of Chicago until May 27 for furnishing general and detail drawings, tools, labor and materials to erect complete, ready for operation, in the Roseland pumping station, to be located at 104th Street and Stewart Avenue, two vertical,

triple expansion, condensing, self-contained, crank and flywheel pumping engines, each engine to have a rating of 25,000,000 U. S. gal. of water per 24 hours, and including a 25-ton electric crane, according to plans and specifications on file in the office of the Department of Public Works, Room 810, City Hall, Chicago. Proposals must be made out on blanks furnished by the above office. John J. Hanberg is Commissioner of Public Works.

CHICAGO, ILL.—Bids will be received until May 12 by I. J. Bryan, clerk of the Sanitary District of Chicago, at Room 1500, American Trust Building, Chicago, Ill., for furnishing and installing a direct-current, compound-wound generator, turbine water wheel unit, switchboard and wiring to electrical apparatus. Proposals may be made upon any or all of the following divisions: Divison A—Direct-current generator and rheostat; Division B—Switchboard panel and electrical wiring; Division C—Turbine water wheel unit. All proposals must be made upon blank forms furnished by the Sanitary District and in accordance with the plans, specifications and contract form on file in the office of the electrical engineer of the Sanitary District of Chicago at the above named office, and which can be obtained upon application therefor.

COLUMBIA, ILL.—The East St. Louis, Columbia & Waterloo Railway Company is making arrangements to commence work on the construction of its proposed electric railway, which will connect East St. Louis, Waterloo and intervening towns, 23 miles in length. The company proposes to furnish electricity for lamps. H. Reichenbach, of Columbia, is secretary and treasurer.

EAST ST. LOUIS, ILL.—The Citizens' Electric Light & Power Company is reported to have submitted a proposition to the merchants of East St. Louis offering to furnish electricity for the system of arches spanning the business streets, which has been in operation since May, 1908, free of cost, provided the merchants will make two-year contracts for their places of business, instead of the customary one-year contracts.

MURPHYSBORO, ILL.—The Murphysboro Street Railway Company has awarded the contract for furnishing poles, wires, cars, etc., for its proposed street car line to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa.

ELKHART, IND.—The Lake Shore Railroad Company has made an appropriation for the immediate installation of telephones along its line between this city and Toledo, Ohio, for the purpose of dispatching trains by telephone.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has procured a site in West Washington Street on the canal upon which to erect and equip a new plant to cost $300,000. It is the purpose of the company to extend its service northward.

NOBLESVILLE, IND.—The White River Light & Power Company, which is constructing a dam across White River, near this city, has disposed of $150,000 of bonds, which means the early completion of the plant. Work has been resumed and 30 days will be required to complete the dam. The generating plant is also nearly completed. The company will furnish electricity for lamps and motors and has several good contracts, including one interurban road.

SOUTH BEND, IND.—The South Bend Home Telephone Company has decided to make extensive improvements to its service in St. Joseph, which will involve an expenditure of about $30,000.

WARSAW, IND.—The City Council has granted the Wabash & Northern Traction Company a franchise to construct and operate an electric railway in Warsaw.

BLOOMFIELD, IA.—The Iowa Telephone (Bell) Company has purchased the local telephone plant for $75,000.

COUNCIL BLUFFS, IA.—Plans are being made by the Independent Telephone Company for improvements to the Mills County system, which will involve an expenditure of from $25,000 to $30,000.

HARTLEY, IA.—The municipal electric light plant has been completed and accepted by the Council. The machinery was installed by the Minneapolis Steel & Machinery Company.

MT. VERNON, IA.—We are informed that the Mt. Vernon Electric Light Company proposes to establish a 24-hour service soon.

BELLEVILLE, KAN.—The Belleville Independent Telephone Company is making improvements to its local plant and is preparing to build copper lines to Mahaska and to the Jewell County line. The cost of the work is estimated at $15,000.

CLAY CENTER, KAN.—Judge Pollock, of the Federal Court, has granted a temporary injunction forbidding the officers of the city of Clay Center from cutting down the poles or interfering with the operation of the electric light plant of the Clay Center Light & Power Company. The city, which owns and operates a municipal lighting plant, has refused to renew the franchise of the Clay Center Light & Power Company, which has been operating the old plant, and attempted to cut down the poles and remove the wires from the streets. The injunction was granted on the application of the Merrimac River Savings Bank of New Hampshire.

COFFEYVILLE, KAN.—The Stevens Electric Company, of this place, has been purchased by Collier & Clark Consolidated Company. The company will be operated under the same name at 114 West Eighth Street, Coffeyville. A. W. Collier is manager.

WINNSBORO, LA.—The Winnsboro Telephone Company is making arrangements to extend its telephone line from Winnsboro to Rayville.

BANGOR, MAINE.—A preliminary survey has been ordered by the Bangor Railway & Electric Company for the proposed extension to the Charleston division of its lines running from Bangor, which will eventually reach Waterville, 52 miles distant. John R. Graham is president.

RUMFORD, MAINE.—Bids will be received until May 8 by the Rumford Falls Power Company for completing the excavations, foundations, stone and concrete masonry, brick station, etc., of the hydro-electric development project started last year. Plans and specifications are on file in the engineer's office, Rumford.

BEVERLY, MASS.—The Selectmen of Topsfield have petitioned the Legislature to pass a bill granting the Beverly Gas & Electric Company permission to do business in Topsfield.

BOSTON, MASS.—The installation of a new electric lighting plant at East Boston is included among the improvements to be made by the Boston & Albany Railroad Company this year.

CLINTON, MASS.—The Connecticut River Transmission Company has applied to the Legislature for permission to erect its high-tension transmission lines over the State reservation of the Wachusset reservoir. The company proposes to extend its transmission line from Clinton to Worcester.

NEW BEDFORD, MASS.—The City Council has awarded the contract for the electrical work on the municipal office building to the Eastern Electrical Company, New Bedford, Mass., for $19,600.

NEW BEDFORD, MASS.—Contracts have been awarded by the New Bedford Cotton Company for the construction of its buildings to the B. F. Smith Company, of Pawtucket, R. I. The plans call for a power plant with an output of 1200 hp, contracts for which will be called for about June 1. Lockwood, Greene & Company, 93 Federal Street, Boston, Mass., are architects and engineers.

ORANGE, MASS.—The Orange Electric Light Company has applied to the State Gas and Electric Light Commissioners for authority to issue $155,000 additional capital stock, the proceeds to be used to pay outstanding indebtedness.

PLYMOUTH, MASS.—The plant of the Plymouth Electric Light Company was damaged by fire April 26, causing a loss of about $50,000. The generators, including a new 400-hp machine, were practically destroyed. The company has made arrangements to secure electricity from the plant of the Brockton & Plymouth Street Railway Company to operate its system. The company also furnishes electrical service in Duxbury and Kingston.

SPRINGFIELD, MASS.—The United Electric Light Company has purchased a site in Brightwood, where it proposes to erect a new substation to furnish electricity for motors. It is said that the company has already placed contracts for 300 hp among the manufacturers.

SPRINGFIELD, MASS.—Plans are being made for extensive improvements by the Springfield Street Railway Company to the local system and on the Westfield Railway, which will involve an expenditure of about $80,000. The work will include the laying of new tracks, wires and electrical equipment. New motors and electrical equipment will be purchased for the cars at a cost of about $25,000. About $40,000 will be expended on the Westfield line.

TOPSFIELD, MASS.—A petition is being circulated to be presented to the Legislature asking for permission to light the town by electricity, to be furnished by a company outside of the town.

BIG RAPIDS, MICH.—The Board of Supervisors of Mecosta County has declared the franchise of the Grand Rapids-Muskegon Power Company forfeited, and has instructed Attorney Barton to institute proceedings necessary to enforce the decision. This includes the Rogers dam, already constructed, as well as other dams contemplated in the franchise which expired by self limitation April 1. The franchise called for several dams, but only one was built.

DETROIT, MICH.—Bids will be received by the Police Commissioner of the city of Detroit, Mich., until May 10 for furnishing 20,000 ft., more or less, of underground cable for the police signal service, as per specifications, which can be secured on application to George A. Walters, secretary.

GLADSTONE, MICH.—The Board of Fire and Water Commissioners is planning to extend and improve the service of the municipal electric light plant and will install a 200-kw, three-phase, 2300-volt, 60-cycle generator and switchboard; construction of substation; 200-kw, 6600-volt to 2300-volt transformers; the construction of two miles of transmission line, and the reconstruction of present lines, changing arc lamps, meters and make other improvements, for which bids have already been received. J. D. Roberts is superintendent.

NILES, MICH.—The Indiana & Michigan Electric Company, which was recently granted a franchise to furnish electricity in Niles for manufacturing purposes, is erecting a substation in this city and will soon be ready to furnish electrical service. Power will be secured from the company's plants on the St. Joseph River at Buchanan and Berrien Springs.

HIBBING, MINN.—Plans are being made for the construction of a new power plant near Hibbings for A. P. Silliman. The plant is to be erected by the Power Equipment Company, of Minneapolis, and the equipment will include a producer gas engine, electric generator, pump, etc.

LUVERNE, MINN.—The Luverne Brick & Tile Company has installed a 150-kw electric generating unit in its plant.

VIRGINIA, MINN.—The Commodor Iron Mining Company, it is said, is planning to install a direct-current electric generating unit to be used for lamps and motors.

WHITE EARTH, MINN.—Plans are being made by the White Earth Telephone Company to extend its telephone lines to Waubun, Ogema and Beaulieu.

MATHISTON, MISS.—W. J. Buckingham is reported to be interested in a project to install an electric light plant.

BRAYMER, MO.—The Central Telephone Company is preparing to erect a telephone line 19½ miles in length. W. H. North, R. D. No. 6, Northborne, Mo., is secretary of the company.

ANACONDA, MONT.—The Washoe Copper Company has taken over the plant and holdings of the Montana Electric Power & Mining Company, including all its water rights, power plants on Flint Creek and other property.

BOZEMAN, MONT.—The Gallatin Valley Electric Railway Company has awarded the contract for the construction of its proposed electric interurban railway between Bozeman and Salesville, 18 miles in length, to Westinghouse, Church, Kerr & Company, New York, N. Y. The company, it is said, will take over the Bozeman street railway system and will operate it in connection with the proposed interurban railway. The company is also contemplating the purchase of equipment for two substations. Charles B. Anderson is secretary of the company.

AUBURN, NEB.—The Auburn Electric Light & Power Company is planning to replace its wooden poles now in use with cement poles. Other improvements are also contemplated.

HOOPER, NEB.—The citizens are considering the question of installing a municipal electric light plant in connection with the water-works system.

PLAINVIEW, NEB.—The city, it is said, will grant a franchise to anyone who will intsall a plant in Plainview. For further information, address H. J. Nelson, city clerk.

LACONIA, N. H.—The Laconia Electric Lighting Company is considering the question of changing the street lighting system in Laconia.

MANCHESTER, N. H.—The Amoskeag Manufacturing Company has decided to locate its new power house north of the Jefferson mill. The equipment of the new power house will include 32 boilers of the Manning type with a rating of 150 hp each. The new power plant will furnish power for the whole northern division, eliminating the present plants at the Langdon, Jefferson and Amory mills.

WINCHESTER, N. H.—The town has awarded a contract to the Keene Gas & Electric Company to furnish electricity to light the streets of Winchester and Ashuelot. The contract is for a term of ten years and calls for 75 tungsten lamps of 40 cp.

HOBOKEN, N. J.—The Citizens' Light, Heat & Power Company, recently organized, has applied to the Common Council for a franchise in this city. The company agrees to enter into a contract to furnish the city with 285 arc lamps at $70 each per year. If a franchise is granted the company agrees to have its plant completed in a year.

TRENTON, N. J.—Plans are being prepared by Ford, Bacon & Davis, of New York, N. Y., for the construction of a new power plant for the Camden & Trenton Railway Company. At present the company secures electricity for operating its system from the Cinnaminson Electric Light, Power & Heating Company and the Bordentown Electric Light & Motor Company.

ALBANY, N. Y.—The Public Service Commission, Second District, has approved the franchise granted to the Municipal Gas Company, of Albany, by the Town Board of Bethlehem to erect transmission lines for the distribution of electricity for lamps, heat and motors on Delaware Avenue from the city line to the Five-Mile House, west of Delmar, and along adjacent streets intersecting and running parallel with Delaware Avenue in the villages of Elsmere, Delmar and Slingerlands in the town of Bethlehem.

BROOKLYN, N. Y.—Bids will be received by Bird S. Coler, borough president, Borough Hall, Brooklyn, N. Y., until May 26 for furnishing all labor and materials required for pumping engine and power plant for operating Gowanus flushing tunnel, Borough of Brooklyn. Blank forms and further information may be obtained and plans and drawings may be seen at the office of Bureau of Sewers, 215 Montague Street, Borough of Brooklyn.

FORT ANN, N. Y.—The Kanes Falls Electric Light Company is enlarging one of its dams to secure more power for its plant.

GOUVERNEUR, N. Y.—Preparations are being made by the Aldrich Paper Company, of Gouverneur, for the construction of a large steel flume at its talc mill at Emeryville. The company is also considering the question of the construction of an electric generating plant and transmission line to Natural Dam to supply electricity to the paper mill operated by the company in that place.

ITHACA, N. Y.—The Ithaca Street Railway Company is planning to commence work on the reconstruction of its system June 1, 1909. It is proposed to double-track the entire railway and rebuild the overhead system. The contract for insulators, etc., for the overhead work has been awarded to the Electric Service Supplies Company, Philadelphia, Pa.

JAMESTOWN, N. Y.—The annual report of the Municipal Light Commission gives the receipts of the municipal electric light plant for the year for lighting, both city and commercial, as $46,085, and the cost of maintaining the plant, including $6,486 for depreciation, $36,356, leaving a profit of $9,729. A substantial reduction in the price of electricity for lamps has been made.

LYONS, N. Y.—The Wayne County Electric Company has increased its rates to consumers of electricity in Lyons and Clyde from $1 to $1.25 per month minimum for residential lighting with a discount of 20 per cent for payment before the 10th of the month. The charge for electricity for motors has been advanced to $1 per month per horse-power with 40 per cent discount if paid by the 10th of the month.

NEW YORK, N. Y.—The contract for furnishing and installing electrical and mechanical equipment on piers according to contract No. 1150 was awarded to the Northeastern Construction Company, of New York, N. Y., for $745,000.

WADHAMS MILLS, N. Y.—The power house located at Meigsville, which furnishes electricity for the local electric light and power system, was badly damaged April 20 owing to the washout of the Payne storage dam of the Witherbee-Sherman Power Company, located at Lincoln Pond. The company recently installed a large General Electric generator, which it is thought is ruined.

ALBERMARLE, N. C.—The Albermarle Development Company has awarded the contract for the construction of its dam to L. A. Moody, of Albermarle. The dam will furnish power to generate electricity for lamps and motors. J. C. Masters is president of the company.

CHARLOTTE, N. C.—It is reported that the Southern Power Company contemplates moving its headquarters from this city to another convenient point. This proposed action, it is stated, is the result of the adoption of an amendment to the city charter whereby the right, not only to regulate the service, but also the charges and rates of public or quasi public-service corporations, and to fix such rates, is vested in the Board of Aldermen. Local corporations of a public character, including telephone, power, lighting, etc., strenuously objected to the measure, which becomes effective May 6, 1909.

FAYETTEVILLE, N. C.—The Carolina Telephone & Telegraph Company has completed its lines to Selma, and a line to Wilson is under construction. Telephone lines from Selma to Welden will be built via Tarboro and other towns, and at Selma connections will be made with the American Telephone and Southern Bell companies.

HENDERSONVILLE, N. C.—The Green River Power Company, recently incorporated, with a capital stock of $100,000, proposes to develop a mountain water power, primarily to furnish electricity in Hendersonville, and also to furnish electrical power to a large cotton mill, which has been organized, and other manufacturing plants and for the proposed Hendersonville street railway system.

LEXINGTON, N. C.—The new Dacotah Cotton Mill, which will be equipped with 8640 spindles and 240 looms to start with, will be operated by electricity supplied by the Southern Power Company.

SILER CITY, N. C.—The Matthews Telephone Company has purchased the Pittsboro, N. C., telephone plant, and is making improvements to its entire system. A new switchboard has been purchased and the Pittsboro system will also be overhauled. The Matthews company owns several telephone lines extending out from Siler City and Pittsboro and a number of long-distance lines.

WAKE FOREST, N. C.—B. Parks Rucker, of Charlotte, N. C., engineer, will have charge of the construction of the municipal electric light plant, for which $15,000 in bonds was recently voted.

BATHGATE, N. D.—Bids will be received by Alexander Morrison, secretary, until May 10 for the construction of power house, tunnel and repairs to main building at the State Blind Asylum at Bathgate, N. D. Plans and specifications may be seen at the office of Joseph Bell DeRemer, architect, Grand Forks, N. D.; also at the Builders & Traders' Exchange, Grand Forks, N. D.; Fargo, N. D.; Minneapolis, Minn., and St. Paul, Minn., and at the office of the secretary at Bathgate, N. D.

ELLENDALE, N. D.—The contract for installing an electric light plant in the State School has been awarded to A. Paul for $3,200.

GRAND FORKS, N. D.—The Grand Forks Street Railway Company is making plans for improvements and extensions to its system, which will include the construction of 3½ miles of track, a new car barn and the installation of a 250-kw generator. Thomas D. Campbell is general manager.

ANTWERP, OHIO.—We are advised that A. A. Painter has purchased the local electric light plant owned by Henry Harris & Son.

CINCINNATI, OHIO.—The contract for furnishing and installing electrical equipment for power plant for the City Infirmary at Hartwell, Ohio, has been awarded to the General Electric Company, Cincinnati, Ohio. John J. Werner is clerk.

CINCINNATI, OHIO.—The Union Gas & Electric Company has submitted a proposition to the City Council for lighting Fountain Square. The company offers to erect and maintain 1600 4-cp, colored festooned electric lamps, to burn from dusk till midnight, 100 nights a year, for $2,166 per year; also for the maintenance of 38 magnetite arc lamps, to burn for five hours, for 100 nights, for $1,558, and for 12 magnetite arc lamps, to burn 3914 hours, for $1,790.

CINCINNATI, OHIO.—The Southwestern Ohio Traction Company has applied to the City Council for a franchise for an underground, elevated and surface railway, from Norwood into the heart of the city, with a branch leading from a point near Vance Street and Columbia Avenue to Carroll Street. If a franchise is granted, the company proposes eventually to operate a system embracing approximately 400 miles, extending half way across the State. The company plans to extend its system from Lebanon to Springfield, either by purchasing the railways now in operation or by the construction of an independent road. An extension will also be built, either from Hillsboro or Blanchester to Columbus, and

when the final plans are consummated the company will have a direct and short line from Cincinnati to Dayton, Cincinnati to Springfield, and Cincinnati to Columbus, with branches to Hillsboro, Georgetown, Bethel and New Richmond and intermediate points. The railway will be operated by the third-rail system.

NATIONAL MILITARY HOME, OHIO.—Bids will be received by W. H. Ortt, treasurer, Central Branch, National Home, Disabled Volunteer Soldiers (P. O. address National Military Home, Ohio) until May 1 for repairs to engine, dynamos, motors, etc., in accordance with instructions and specifications, copies of which with blank proposals and other information can be secured upon application to W. H. Ortt, treasurer.

NEWARK, OHIO.—The Licking Light & Power Company is considering the question of installing a 500-kw gas engine unit.

NEW CARLISLE, OHIO.—The capital stock of the Springfield-New Carlisle Telephone Company has been increased from $20,000 to $40,000, the proceeds to be used for a new plant.

PIQUA, OHIO.—The plant of the Home Telephone Company, of this city, was recently destroyed by fire, causing a loss of about $40,000.

PLAIN CITY, OHIO.—At a recent election the proposition to issue bonds for improvements to the municipal electric light plant was defeated.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company has purchased a site on Buck Creek, west of Fountain Avenue, on which a new power plant will be erected. The plant, when completed, will involve an expenditure of about $200,000.

WEST MILTON, OHIO.—It is expected that the new electric light plant will be completed and in operation in about 30 days. The plant will be operated by water power and will have an output of about 165 hp. The cost of the entire system is estimated at about $10,000. L. A. Pearson is owner of the plant.

YOUNGSTOWN, OHIO.—It is understood that the new tube and skelp departments of the Republic Iron & Steel Company will be operated by electricity generated by furnace gas from the Haselton furnaces of the company.

YOUNGSTOWN, OHIO.—The Carnegie Steel Company is making plans to change the power of its plant from steam to electricity. The company is now installing four gas engines to be driven by furnace gas from the blast furnaces. Four new 2000-kw generators are also being installed in the plant, which will be driven by the gas engines. A storage battery is also used in connection with the plant.

MEDFORD, OKLA.—D. E. Stetler writes that the project of the Medford Ice, Light & Power Company to erect an electric plant in Medford has been abandoned, and states that there is a good opening for the establishment of an electric plant in the town.

MINCO, OKLA.—The contract for the construction of water works and electric light plant has been awarded to the Joplin Electric Construction & Supply Company, of Joplin, Mo., for $12,284. Burns & McDonnell, of Kansas City, Mo., are consulting engineers.

BUTTE FALLS, ORE.—Plans are being considered to erect a telephone line from Butte Falls to Eagle Point. B. H. Harris is interested in the enterprise.

EUGENE, ORE.—The Eugene-Pacific Electric Railway Company, recently formed for the purpose of constructing an electric railway from Eugene to Florence, is making surveys of the route and a report has been placed in the hands of capitalists for examination. The plans include the development of a water power to be used to generate electricity. All of the stock of the company is owned by the Lane County Asset Company. Frank E. Dunn, of Eugene, Ore., is president, and Lohman & Company, of San Francisco, Cal., are the engineers.

FOREST GROVE, ORE.—The United Railways Company has submitted a proposition to the Board of Trade offering to extend its railway from Portland to Forest Grove, providing this city will furnish a 10-acre tract about a mile north of the town for terminal and switching ground and the right of way.

PORTLAND, ORE.—The injunction brought against the city to restrain it from building a municipal electric light plant has been decided in favor of the city. Unless appealed, it is said that work will soon commence on construction of the plant, the cost of which is estimated at $130,000.

PORTLAND, ORE.—The Portland, Baker City & Butte Electric Railroad Company, which proposes to construct an electric railway from Portland to Baker City and thence to Butte, crossing the Warm Springs Indian reservation and Central Oregon, a distance of about 600 miles, has received permission from the Department of the Interior to make a survey of the reservation. It is proposed to erect a steam plant with an output of 8000 hp in Portland, and additional power will be secured from the Wasco County Electric & Water Power Company's plant, located on the Deschutes River. The company is capitalized at $2,000,000 and a bond issue of $40,000,000 has been authorized. H. C. McAllister is president, and C. D. Charles, general manager.

RICHLAND, ORE.—J. L. Bisher has been granted a franchise by the county court to erect a telephone line from Richland to Robinett.

SALEM, ORE.—The Mehama Telephone Company has filed a petition with the county court for a franchise to erect a number of telephone lines in this county.

ALLENTOWN, PA.—The Inter-County Electric Company, which proposes to construct an electric railway between Reading and Allentown, has applied to the City Council for a franchise to construct and operate its system in Allentown.

BELLEFONTE, PA.—Bids will be received by W. T. Kelly, borough clerk, until June 1, for the construction of a complete electric power plant, including a concrete dam, races, water wheels, generator, reconstruction of power house building, transmission line, motor-driven pump, etc., in accordance with plans and specifications on file at the office of the city clerk, and at the offices of D. C. & William B. Jackson, 84 State Street, Boston, Mass. G. F. Musser is chairman.

BUTLER, PA.—The People's Telephone Company, of Butler, has increased its capital stock from $100,000 to $200,000.

PHILADELPHIA, PA.—Bids will be received by the Frankford Arsenal until May 26 for supplies for the year ending June 30, 1910, which will include steel, iron and copper tubing, electrical supplies, etc. Blanks can be had on application to the commanding officer.

PITTSBURGH, PA.—Surveys are being made for the Pittsburgh & Suburban Railroad Company for its proposed railway from Pittsburgh to Carnegie and Steubenville, a distance of about 40 miles. J. Toner Barr, 237 Fourth Avenue, Pittsburgh, Pa., is engineer.

PITTSBURGH, PA.—A bill has been presented to the City Council providing for the removal of all overhead wires and poles of the telegraph, telephone, electric and light companies from the streets of the city, the work to begin on or before July 1, 1909, and to be completed by July 1, 1913.

READING, PA.—The City Council has authorized the police committee of the council to advertise for bids for lighting the streets and city hall for a period of one, two, three, five or ten years.

SOUTHAMPTON, PA.—The Philadelphia Suburban Traction Company, of Philadelphia, Pa., contemplates the construction of an electric railway from Southampton to Hatboro. The company will soon make application for a charter. W. E. Watt, J. L. Crogan, H. C. Case, J. A. Bonnell and W. A. Merrisk, of New Town, are interested in the company.

WASHINGTON, PA.—Application will be made on May 17 by C. B. Coldwell, J. W. McKay, M. J. Hosack, E. B. Hartman, Jr., and Roger Knox for a charter for the Washington-Marianna Street Railway Company to construct a street railway from Washington to South Strabane Township.

WAYNESBURG, PA.—Plans have been completed for the construction of a new electric traffic system, which will radiate in four directions from Waynesburg, with Washington, Wheeling, Uniontown and Morgantown as its terminals, work on which will begin about the middle of this month. The company will be known as the Waynesburg & Monongahela Street Railway Company, and its officers are: Peter Langsdorf, of McKeesport, Pa., president; W. J. Sheldon, of Waynesburg, vice-president; J. Carson Sheldon, of Buffalo, N. Y., secretary, and Charles O. Koehler, of McKeesport Pa., treasurer. The entire system will consist of about 100 miles of track of which 50 will be built this year.

WILKES-BARRE, PA.—Sealed proposals will be received by Fred H. Gates, city clerk, until May 20 for lighting certain streets of the city with electric arc lamps. Plans and specifications can be seen and blank forms obtained from the city clerk.

WOONSOCKET, R. I.—Preparations are being made by the Scotia Worsted Company for the construction of a new power house adjoining its mill on River Street. A 350-hp compound engine and new boilers will be installed.

CHESTER, S. C.—The Southern Power Company, which recently purchased the municipal electric plant, is overhauling the street lighting system, and expects to have the new system in operation soon. The company will also furnish electricity to industrial plants, etc. The Springstein and Eureka cotton mills have contracted for power to operate their plants, and the Wylie mills will use several hundred horse-power as supplementary to its plant.

LAURENS, S. C.—The Watts Cotton Mills have let the contract to the Piedmont Electric Company, of Anderson, to equip the mill to be operated by electricity. The company is changing its mill from steam to electric drive.

COVINGTON, TENN.—The Memphis, Covington & Northern Railway Company contemplates the construction of an electric railway to connect Memphis, Millington, Mumford and Covington. No definite plans have yet been made for securing power to operate the railway. G. B. Gillespie, of Covington, is president, and J. T. Garner, secretary and treasurer.

KNOXVILLE, TENN.—The county court has granted Charles Dawes a franchise to construct an electric railway from Knoxville to Bearden, with branches to Concord and Lyons View.

NASHVILLE, TENN.—Application has been made to the City Council by the Nashville Railway & Light Company for a franchise to extend its tracks out Broadway and on the Hillsboro pike.

AUSTIN, TEX.—The Austin City Telephone Company was sold at auction April 6 to the Columbus Savings Bank & Trust Company (a Missouri corporation) for $63,000. The company has been in the hands of a receiver since October, 1907.

GROVETON, TEX.—The capital stock of the Groveton Light & Ice Company has been increased from $20,000 to $25,000.

HOUSTON, TEX.—Stone & Webster Engineering Corporation, Boston, Mass., it is said, contemplates improvements to the power plant of the Houston Electric Company, which will involve an expenditure of about $150,000 and will include the installation of an 800-kw unit, with two 500-hp boilers and two new stacks. David Daly is local manager.

HUBBARD CITY, TEX.—The Union Central Light & Ice Company writes that it would like to correspond with contractors with a view of making improvements to its plant, the contractor taking bonds of the company in payment of the work, for which $100,000 6 per cent bonds will be issued. In addition to the bonds, the bonuses from the four surrounding towns will be turned over to the contractor. The work will include the construction of a new power house, new ice machinery and transmission lines to four surrounding towns. W. A. Bass is president of the company.

STAMFORD, TEX.—The Stamford Street Railway Company has been organized to construct a street railway in Stamford which is to extend to the College Heights addition. The railway will be five miles in length. L. M. McArthur, of Stamford, is chief engineer.

TAFT, TEX.—The Coleman-Fulton Pasture Company is making arrangements to install an electric light plant in connection with its ice and cold-storage plants. The plant will have sufficient output to supply electricity for 1000 lamps and to operate both plants. Joseph F. Green is secretary and superintendent.

TRINITY, TEX.—It is reported that A. R. McDonald will establish an electric light plant in Trinity

ST. GEORGE, UTAH.—A company has been organized to construct and operate an electric power plant in St. George. The company is capitalized at $20,350. The officers are: A. H. Ensign, president; George Z. Edwards, vice-president; R. J. Evans, secretary and treasurer, and B. E. Slosson, manager.

DAYTON, VA.—The Silver Lake Improvement Company contemplates the construction of a hydro-electric plant. W. D. Heatwole is president.

DAYTON, VA.—At an election to be held May 12 the citizens will vote on the proposition to issue $20,000 in bonds, the proceeds to be used for extensions to the municipal electric light plant and sewer system.

POCAHONTAS, VA.—The power, fan and boiler houses and machine shops of the Big Vein Coal Company was destroyed by fire April 20, causing a loss of $25,000.

ANATONE, WASH.—The Anatone Water & Light Company has been granted a franchise to operate in Anatone.

COLFAX, WASH.—The Commissioners have revoked the franchise granted to the Whitman Railroad & Power Company to construct and operate an electric railway between Colfax and Palouse. The franchise was granted five years ago and the company has failed to comply with the terms.

COLVILLE, WASH.—The Pacific States Telephone Company, it is stated, has appropriated $85,000 for improvements to its system in Stevens County.

SEATTLE, WASH.—The contract for furnishing electricity to operate the county rock crusher at Kapowsin has been awarded to the Puget Sound Power Company, at 2½ cents per kw-hour.

SPOKANE, WASH.—The Spokane & Inland Empire Railroad is planning to install a transformer in Steptoe to furnish electricity for lamps.

SPOKANE, WASH.—The Big Bend Light & Power Company is erecting a transmission line from Whitefish, Mont., to Kalispell, Mont., a distance of 18 miles, where it will connect with system of the Kootenai Valley Power Company. The company is now operating a steam plant in Whitefish and expects to have the transmission line completed by August, when the system will be changed over. W. C. Sivyer is president.

SPOKANE, WASH.—The Spokane & Inland Empire Railroad Company has applied to the City Council for a franchise to extend its system to Rockwood Boulevard, Lincoln Heights and Allendale. The company proposes to use iron poles and electric lamps will be placed on the poles, which will be maintained by the company. This is done voluntarily and is not a requirement of the franchise.

SPOKANE, WASH.—J. C. Ralston, city engineer, has submitted his report in regard to the construction of a municipal electric light plant. Mr. Ralston states that the cost of the plant would be $2,800,000, including the cost of the site, which would be $300,000. He also states that the use of the power at the up-river pumping station was not feasible. He does not advise the city to go to the expense of installing a plant, as he considers that the present company furnishing the service has the ideal situation, centrally located.

WASHOUGAL, WASH.—The contract for the installation of an electric plant has been awarded to the Pacific Electric Engineering Company, of Portland, Ore. The company will be known as the Western Light & Power Company. It is expected to have the plant in operation by Sept. 1. C. W. Cottrell is interested in the enterprise.

WENATCHEE, WASH.—Jay L. Holmes and others have filed a notice of appropriation of 25,000 cu. in. of water in the Icicle River, to be utilized to generate electricity. One of the objects in view is the erection of a large greenhouse to be heated by electricity.

JANESVILLE, WIS.—The Wisconsin Carriage Company is preparing plans for the construction of a new plant to be operated with electric motors.

MILWAUKEE, WIS.—The new plant of the Davis Manufacturing Company, which will be operated by electricity, is nearly completed.

MILWAUKEE, WIS.—The Milwaukee Western Electric Railway Company has recently awarded the contract for financing and construction of its proposed electric railway, 65 miles in length, to W. D. Chapman, of Akron, Ohio. The railway will connect Milwaukee and Beaver Dam and intervening towns. A branch line will extend from Sussex to Waukesha.

RICE LAKE, WIS.—Plans are being considered by the Red Cedar Electric Power Company for enlarging its plant.

STOUGHTON, WIS.—Plans are being made by the Mandt Wagon Company to change its plant to be operated by motor drive.

SUPERIOR, WIS.—The Northern Pacific Railroad Company is said to be making plans to construct new ore docks along the harbor front and to operate the machinery by electricity, which will be supplied from the power plant of the Great Northern Power Company.

WAUSAU, WIS.—The Marathon Paper Mills Company is advertising for bids for the construction of a new plant. The company has awarded a contract for power and electrical equipment to the Allis-Chalmers Company, of Milwaukee, Wis.

VICTORIA, B. C., CAN.—The Board of Aldermen is considering the question of securing electricity from the British Columbia Electric Company to supply additional lamps for the present, instead of making extensions to the municipal plant this year as planned, which would require an expenditure of about $20,000. It is estimated that the company can provide street lamps at $38 each per year, which will save the city about $10,000 per year.

MINIOTA, MAN., CAN.—The Miniota Municipality is making preparations for the construction of a rural telephone system. For further information address Reeve Gerrand, Miniota, Man.

LISTOWELL, ONT., CAN.—The citizens on April 19 voted to install a municipal electric light plant to cost $12,500 for both street and commercial lighting. The old arc-lamp equipment will be sold and tungsten lamps will be installed for street lighting.

PORT ARTHUR, ONT., CAN.—The Street Railway Commissioners have decided to call for tenders for four pay-as-you-enter cars. For further information address J. J. Carrick.

TORONTO, ONT., CAN.—The city of Toronto will soon call for bids for laying of underground conduit. Specifications can be secured on application to the Electrical Department, City Hall, Toronto.

WELLANDPORT, ONT., CAN.—The Dunnville, Wellandport & Beamsville Electric Railway Company is advertising for bids for grading for its proposed electric railway, which will connect Dunnville, Wellandport and Beamsville. The company has decided to purchase electricity to operate the road. James A. Ross, of Wellandport, is treasurer.

QUEBEC, QUE., CAN.—It is reported that the controlling interest of the Quebec Railway, Light & Power Company has passed into the hands of a syndicate, which is desirous of extending the railway to Murray Bay, a distance of 56 miles. The railway will start from St. Joachim and will cost about $2,000,000.

NORTH BATTLEFORD, SASK., CAN.—The proposition to issue $75,000 in bonds, the proceeds to be used for the installation of an electric light plant, water works and sewer system, will be submitted to a vote of the people.

NORTH BATTLEFORD, SASK., CAN.—Willis Chipman, civil engineer, of Toronto, Ont., has been retained to prepare plans for a municipal electric lighting system in North Battleford.

MEXICO CITY, MEX.—Augusta Pellet has filed a petition for a concession of water rights in the Vado or Tequesquipan rivers in the State of Mexico, to be utilized for the generation of electricity.

## Company Elections.

NAPA, CAL.—At the annual meeting of the Vallejo, Benicia & Napa Valley Railroad Company the following named officers were elected: W. T. Botsford, president; E. Z. Hennessey, vice-president; John T. York, secretary.

HOBOKEN, N. J.—The Citizens' Light, Heat & Power Company has been organized by the election of the following-named officers: Anthony J. Volk, president; Frank Cordts, vice-president; Henry Lohmann, Jr., secretary, and John F. O'Hara, treasurer.

UTICA, N. Y.—At the annual meeting of the Utica Gas & Electric Company the following officers were elected: Anthony N. Brady, president; William E. Lewis, vice-president; M. Jesse Brayton, secretary; George H. Stack, treasurer, and C. A. Greenidge, general manager of the electric department.

## New Industrial Companies.

THE AMERICAN OIL ENGINE COMPANY, of Portland, Maine, has filed articles of incorporation with a capital stock of $500,000 for the purpose of manufacturing and dealing in engines, tools, etc. C. E. Eaton is president, and T. L. Croteau, treasurer, both of Portland, Maine. The company, it is said, will take over the business of the International Oil Engine Company, of Danielson, Conn., which manufacturers stationary, marine and automobile engines.

THE B. & L. ELECTRICAL CONTRACTORS, of Brooklyn, N. Y., have been chartered with a capital stock of $5,000 by Julius A. Bychower, Pauline Bychower and A. Charles Teplitz, all of Brooklyn, N. Y. The company proposes to do electrical work.

EDWARD JOY, of Syracuse, N. Y., has filed articles of incorporation with the Secretary of State for the purpose of carrying on the business of contracting electrician, plumbing, steam- and hot-water heating business. The incorporators are: E. Joy, E. F. Joy and P. R. Joy, all of Syracuse, N. Y.

THE ELECTRIC SUPPLY COMPANY, of Richmond, Va., has been chartered, with a capital stock of $10,000, to conduct an electric supply business. F. J. Whybrow is president.

THE ERD MOTOR COMPANY, of Saginaw, Mich., has been incorporated with a capital stock of $22,000 by John G. Erd, Henry S. Erd and William J. Passolt.

EUREKA VIBRATOR COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing and selling vibratory or electrical devices and novelties. The incorporators are: F. R. Muenzenberger, W. Muenzenberger and K. T. Muenzenberger, of New York, N. Y.

THE FIDELITY ENGINEERING & INSPECTING COMPANY, of Albany, N. Y., has been incorporated with a capital stock of $2,000 by Wallace Greenlach, Manning Boulevard, Edward J. Wheeler, of Albany, N. Y., and Albert B. Hager, of Albany, N. Y. The company proposes to do a general engineering, inspecting and testing business.

THE IDEAL POST COMPANY, of Portland, Ind., has incorporated to establish and equip a plant for the manufacture of concrete telephone and telegraph poles, together with the necessary apparatus for setting such poles. H. H. Gilmore, B. G. Arthur and M. C. Gaunt are directors.

THE INDEPENDENT ELECTRICAL COMPANY, of Salt Lake City, Utah, has been incorporated with a capital stock of $20,000 for the purpose of dealing in electrical supplies. The officers of the company are: Nephi L. Morris, president; Heber C. Iverson, vice-president; Eugene Chandler, treasurer, and L. J. Haddock, secretary.

THE KEYSTONE ENGINEERING COMPANY, of Wilmington, Del., has been chartered with a capital stock of $100,000 by W. B. Affleck, W. C. Hardy and R. R. Adams, of Philadelphia, Pa.

THE LINCOLN ELECTRIC COMPANY, of Hammondsport, N. Y., has been incorporated with a capital stock of $75,000 by W. B. Putney, Jr., R. Kelly, of New York, N. Y., and W. H. Griffin, of Matawan, N. J. The company proposes to manufacture electric batteries, instruments and supplies.

THE McCORD ENGINEERING COMPANY, of Atlanta, Ga., has been incorporated by J. L., W. P. and C. M. McCord. The company proposes to do a general electrical, mechanical and civil engineering and contracting business.

THE NATIONAL BURGLAR ALARM COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000. The company proposes to manufacture, erect and operate burglar alarms and warning instruments. The incorporators are: Frank L. Smiley, Bernard C. McKenna and Scudder J. Wooley, all of New York, N. Y.

THE NEW ENGLAND ENGINE COMPANY, of Augusta, Maine, has been chartered with a capital stock of $200,000 to manufacture engines, dynamos, tools, etc. R. S. Buzzell is president, and E. J. Pike, treasurer, both of Augusta, Maine.

THE PAGES' AEROPLANE RAILWAY COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $100,000 by C. H. Pages, E. D. Kenyon, of Brooklyn, N. Y., and W. W. Heroy, of Bronx. The company proposes to manufacture cars, railway, tramway or aeroplanic, for passengers and freight and for amusement, toys, etc.

THE TRIPLE MOTOR TRUCK COMPANY, of Owosso, Mich., has been chartered with a capital stock of $340,000. F. O. Page, formerly of the Reliance Motor Company, is at the head of the new company.

THE UNION ELECTRIC MANUFACTURING COMPANY, of Pekin, Ill., has been incorporated with a capital stock of $6,000 by George H. Glass, George A. Vint and James W. Barrett. The company proposes to manufacture and deal in electrical tools, machinery and appliances.

## New Incorporations.

DENVER, COL.—The South Platte Power Company has been chartered, with a capital stock of $50,000, by W. J. McConnell, Charles L. Barthen and Edwin J. Moore, of Denver, Col.

DENVER, COL.—The San Luis Valley Water & Power Company has been incorporated, with a capital stock of $1,000,000, by Fred G. Moffat, Gerald Hughes, H. A. Smith, George Bierbauer, H. G. Lunt and Franklin E. Brooks.

WILMINGTON, DEL.—Articles of incorporation have been filed for the Ambridge Heat, Light & Power Company with a capital stock of $150,000 by F. A. Heberlin, E. G. Schell and J. R. Miner, of Ambridge, Pa.

MIAMI, FLA.—The Miami Electric Light & Power Company has been incorporated with a capital stock of $50,000 to supply electricity for lamps, heat and motors in Miami, Fla. The incorporators are: J. R. Parrott, H. S. Jennison, A. V. S. Smith, of Jacksonville, Fla.; J. N. McConigle, of Miami, Fla., and C. D. Boice, of Jersey City, N. J.

ATLANTA, GA.—Articles of incorporation have been filed for the Coosawattee & Mountaintown Rivers Power & Improvement Company, with a capital stock of $50,000, with the privilege of increasing it to $500,000, by William M. Scott, E. W. Watkins, Jr., and E. W. Watkins, Sr. The company owns water power properties in Gilmer County and proposes to construct a hydro-electric plant, developing about 4000 hp for transmission. Hall Brothers, of Atlanta, Ga., are engineers in charge of the work.

PINEORA, GA.—The Effingham Telephone Company has been chartered, with a capital of $5,000 with privilege to increase it to $50,000. The company proposes at present to take over several lines running into Pineora.

BOISE, IDAHO.—The Northern Idaho & Montana Power Company has filed articles of incorporation with a capital stock of $3,000.

MONTEZUMA, IA.—The Montezuma Electric Light, Power & Heating Company has been incorporated with a capital stock of $6,000.

NEW SHARON, IA.—The New Sharon Public Utility Company has been chartered, with a capital stock of $50,000, by W. J. Nicholson and others. The company proposes to construct and maintain telephone, electric and gas plants, etc.

BRIDGEWATER CENTER, MAINE.—The Bridgewater Electric Light & Water Company has been organized and the following named officers elected: J. H. Farley, president; J. C. Burtt, treasurer, and E. B. Morton, clerk. It is said that the company will commence work at once on construction of a substation and distributing system in Bridgewater.

HINSDALE, N. H.—The Hinsdale Power & Mills Company has filed articles of incorporation with the Secretary of State, with a capital stock of $40,000.

ELIZABETH, N. J.—The Mutual District Telegraph & Messenger Company has been incorporated with a capital stock of $100,000 by J. A. McClary, of Rahway, N. J.; G. W. Blanchard, H. W. Pope, of New York, N. Y.; W. B. Moorewood, of Elizabeth; H. L. Benedict, of Union, N. J., and E. K. Summerwell, of East Orange, N. J. The company proposes to operate telegraph and telephone lines.

JERSEY CITY, N. J.—The Interstate Light & Power Company has been chartered with a capital stock of $750,000 by H. O. Coughlin, S. A. Anderson and J. R. Turner, of Jersey City, N. J. The company proposes to generate and distribute electricity for light, heat and motors.

## Legal.

SALE OF ROCKINGHAM POWER COMPANY.—United States Judge J. C. Pritchard has issued an order returnable in chambers in Richmond, Va., May 8, to all parties interested to appear before him in the aforesaid city to show cause why the property of the Rockingham Power Company, of Rockingham, N. C., should not be sold under order of the court. It is generally reported that the court will order the sale and that the developement will be further prosecuted on a large scale to complete the Blewitt-Falls hydro-electric plant.

DEATH OF CHILD BY CONTACT WITH ELECTRIC LIGHT WIRE.—Where it reasonably may be said that an ordinarily careful and prudent person observing the highest degree of care would anticipate that persons in the exercise of lawful right might be brought into contact with wires carrying powerful currents of electricity, the law charges the owner of such wires to insulate them and to maintain them in a proper state of repair. This broad principle found application in a recent Missouri case. The case was one where a small boy, playing upon the roof of the tenement in which he lived with a ball, which rolled off the roof into the yard below, crawled to the edge of the roof to see if he could locate the lost toy. In doing so he seized the metal edge of the roof and his forehead came in contact with an electric light wire belonging to the defendant company, at a point where the insulation had been worn off, causing his death. After the jury had been instructed by the court that it should find in favor of the plaintiff, unless the defendant company established that the child was killed by his own negligence, and "not by the negligence of the defendant," a verdict was given against the company. On appeal, this was reversed for the reason that the instruction was erroneous. The burden was upon the plaintiff to the end of the trial to show that the negligence of the defendant caused the injury, and a defense was made out by the company upon its proving that the negligence of the boy contributed to the accident. Day vs. Consolidated Light, Power & Ice Company, Kansas City Court of Appeals, 117 S. W., 81.

DUTY OF ELECTRIC LIGHT COMPANY AS TO WIRES NOT OWNED BY IT.—The Kentucky Court of Appeals, in a case where a person had been killed by taking hold of an electric light wire which had fallen to the street, and which was used by the defendant company for the transmission of electricity, although it was not owned by the company, expressed the following opinion as to the duty of the company under the circumstances: "The company could not escape its responsibility as the dispenser through the public streets and roads of such a stealthy deadly force as an electric current of such high voltage upon insecure lines of wire, where the public might reasonably be expected. No more could it dispense with the duty of inspecting the wires, from time to time, to see that they were securely fastened and properly insulated, although the lines were not owned by it. When it used the lines it was its duty to see to their proper and safe condition. This duty was not discharged by the exercise of ordinary care, but required the highest degree of care to keep them safe. If the wire broke because of the storm of Sunday morning (the injury occurred late Sunday afternoon), and the

company did not know that it was broken, and could not in the exercise of that degree of care exacted of it by the law have discovered it, then it would not be negligent in failing to discover it; but, having knowledge of the manner in which the wires were strung, the length of time they had been exposed and in use, and that the insulation was off much of the wire, whether then it was negligent in failing to inspect and discover the break, from whatever cause it may have occurred, for more than 12 hours in the daytime, is a question for the jury." Lewis Administrator vs. Bowling Green Gaslight Co., Court of Appeals of Kentucky, 117 S. W. Rep., 278.

## Personal.

MR. W. A. WINFIELD has been appointed manager of the Eastern Telephone Company, with headquarters at Halifax, N. S.

MR. WILLIS CHIPMAN, of Toronto, Can., has been commissioned by the town of North Battleford, Saskatchewan, to prepare plans for a municipal lighting plant.

PROFESSOR MORGAN BROOKS, of the department of electrical engineering of the University of Illinois, has been granted a leave of absence for the purpose of foreign travel and study during the coming academic year.

MR. KEMPSTER B. MILLER, of Chicago, is making a short trip to California, where his firm of McMeen & Miller has extensive telephone work under way. Mr. Miller will combine both business and pleasure during his brief stay.

MR. M. L. KOHLER, of Philadelphia, was elected president of the Chicago Mica Company, of Valparaiso, Ind., at a meeting of the directors held in Chicago on April 14. Mr. Kohler succeeds Mr. F. N. Boyer, resigned. Mr. E. H. Heilstedt was re-elected secretary-treasurer.

MR. SAMUEL INSULL, president of the Commonwealth Edison Company, of Chicago, has returned to his desk after a short trip to London, whence he returned rested and refreshed. Mr. Insull arrived in New York on April 23 and took up his duties in Chicago on April 26.

MR. F. N. BOYER, assistant manager of the Chicago office of the General Electric Company, has returned from a visit to Southern California and Honolulu, where he spent eight months in search of health. The many friends of Mr. Boyer will be pleased to learn that he has fully recovered his health.

MR. GEORGE B. TRIPP, of Colorado Springs, who has recently made a trip East, says that the business outlook in Colorado and throughout the mountain States is very encouraging, and that the general feeling is distinctly one of cheerfulness. Mr. Tripp is general manager of the Colorado Springs Electric Company, the Colorado Springs Gas Company and the Pikes Peak Hydro-Electric Company.

MR. J. INGLES MATTHIAS has resigned as general manager of the Licking Light & Power Company, Newark, Ohio, to take effect July 1, 1909, on which date he will leave for Wilmington, Del., for a rest in the country near that city before returning to active work. Mr. Matthias had a hard struggle in placing the Newark property on a paying basis, but at last succeeded, and now seeks a new field.

MR. A. W. ZAHM, who has been traveling for the Northwestern Electric Equipment Company, of St. Paul, Minn., on May 1 resumes the management of the People's Gas & Electric Company, of Mason City, Ia., which position he held for a number of years before his connection with the Northwestern company. Mr. Zahm is an ex-president of the Iowa Electrical Association and very well known among Iowa central-station men.

MR. J. D. A. CROSS, who has been representing the General Electric Company, with headquarters at Des Moines, Ia., is to become manager of the electric heating appliance department at the Chicago office of the General Electric Company, to fill the vacancy caused by the resignation of Mr. E. L. Callahan, who will take charge of new business departments of central-station companies controlled by H. M. Byllesby & Company on June 1.

MR. WALTER GOLL, manager of the Chicago office of the Fort Wayne Electric Works, who has been one of the most popular members of the electrical fraternity in Chicago, has removed to Madison, Wis., having charge of the general sales organization and factory work of the Northern Electrical Manufacturing Company, now controlled by the Fort Wayne Electric Works. For the present Mr. Goll retains the managership of the Chicago office, but Mr. A. L. Pond, who has been appointed assistant manager of that office and who is well fitted by ability and experience to handle the business, will be in immediate charge in Chicago. Mr. Goll will make occasional trips between Madison and Chicago, making his headquarters in the former city.

MR. RICHARD T. LAFFIN has become associated with the Stone & Webster Management Association in connection with the Seattle Electric Company and other Puget Sound railway and lighting properties. Mr. Laffin was for many years connected with the Boston Elevated Railway, and was later general manager of the Worcester Consolidated Street Railway. He resigned from the latter position to become vice-president and general manager of the Manila Electric Railroad, and spent about four years in the Philippines in establishing and organizing the property, having only recently returned to this country.

COL. W. B. WILSON, the well-known historian of the telegraph in the Civil War and a special agent of the Pennsylvania Railroad, with which he has been connected for 54 years, has just retired under the pension rules of the company, in which he became a telegraph operator at the age of 16. On May 3, 1861, he was taken to Washington by President Scott, of the Pennsylvania Railroad, and made manager of the military telegraph office in the War Department, where he served for 14 months. His services have been recognized from time to time by Congress and other bodies, and he has been elected more than once president of the Old Time Telegraphers' Association and of the U. S. Military Telegraph Corps' Association. In addition to his excellent literary work in the electrical field, Col. Wilson has written a history of the great railroad which is the only continuous narrative extant of the growth of the system.

MR. E. L. CALLAHAN, who has been for the past three and a half years in charge of the sale of electric heating appliances for the General Electric Company, with headquarters in Chicago, has resigned, to take charge of the new business departments of the various electric light, railway and gas properties controlled by H. M. Byllesby & Company, Chicago. Mr. Callahan, who is very well known throughout the Central States for his excellent work in the promotion of electric heating among the central-station companies, is 34 years of age and was graduated from the Case School of Applied Science, Cleveland, in the class of 1900. For three years he was assistant manager of the Simplex Electric Heating Company, and for two and a half years was manager of the Prometheus Electric Company. Previous to entering the electrical field he was with Westinghouse, Church, Kerr & Company in connection with the electrification of the Pennsylvania tunnel. In his new position he will have direction of the new business campaigns of 12 companies. His experience of the past few years in assisting central stations to build up heating appliance loads and his notable success in this work have fitted him admirably for this recent promotion.

E. L. CALLAHAN.

MR. B. R. SHOVER, electrical engineer of the Indiana Steel Company, was born on Feb. 13, 1867, at Dublin, Ind. His high school training was obtained in Indianapolis, and his college education at the Rose Polytechnic Institute, from which he was graduated in 1890. Mr. Shover was employed successively by the following companies: Nevens Electric Heating Company, Indianapolis, Ind.; Richmond City Railway Company, Richmond, Ind.; Seashore Electric Railway Company, Asbury Park, N. J.; Asbury Park Electric Light & Power Company, Asbury Park, N. J.; Youngstown Street Railway Company, Youngstown, Ohio; Carnegie Steel Company, Youngstown, Ohio, and the Indiana Steel Company, Gary, Ind. Mr. Shover has made a special study of electric-motor applications in steel mills, including the requirements of the various mill processes and the characteristics of the electric motors which permit them to meet such requirements. It was his knowledge and experience along these lines that caused him to be selected for his present position as electrical engineer of the Indiana Steel Company. Upon him fell the task of selecting the electrical equipment for the steel mills at Gary, and rearranging the mills so that they could be driven most advantageously by means of electric motors. The successful operation of these mills represents the most important advance made in steel mills and motor applications within many years.

B. R. SHOVER.

## Obituary.

DR. F. B. MANDEVILLE died in Newark N. J., April 26. He was one of the organizers of the old Schuyler Electric Light Company in Newark, which is now one of the constituent companies of the Public Service Corporation, and was its first vice-president and afterward president. Deceased was born in 1840.

MR. ALMON H. DEMRICK, electrical engineer of the United States Reclamation Service, Salt River Project, Roosevelt, Ariz., was drowned May 3 in the sluicing tunnel, 600 ft. long, cut through a mountain at one end of the Roosevelt storage reservoir. While in the tunnel with Mr. A. L. Harris, a civil engineer, a gate was inadvertently opened, thereby admitting water under 90 ft. head; Mr. Harris was swept through the tunnel without loss of life. Mr. Demrick, who formerly lived in Detroit.

was 36 years old. He had been with the project about six years and among other work had built a 65-mile electric transmission line through the mountains from Roosevelt to Phoenix. He was an associate member of the American Institute of Electrical Engineers.

MR. RALPH SCOTT, of the Scott Electrical Company, of Newark, N. J., died at his home in that city last week following an operation for appendicitis. Mr. Scott was born 26 years ago in Bradford, England, and brought to this country by his parents when a child. His academic education was received at Wilkes-Barre, Pa., where for a time he was an instructor at the New Century School in Wilkes-Barre. Mr. Scott went to Newark about two and a half years ago, where he founded the Scott Electrical Company, taking up, among other things, the manufacture of flaming-arc lamps. A lamp of this type made for the Lackawanna Hoboken terminal was of enormous size, the globe being 6 ft. in diameter.

MR. JAMES JONES, SR., formerly of Pearce & Jones and J. Jones & Son, died April 26 from pneumonia, at the age of 77, having been born in Birmingham, England, Sept. 20, 1832. Becoming interested in electricity when a young man, he came to New York City in the belief that he would there find better opportunities for advancement in that branch, and obtained employment with Chester & Company. For about 25 years he was a partner in the firm of Pearce & Jones, manufacturers of telegraph, telephone and fire-alarm apparatus. Later, with his son, he established the firm of J. Jones & Son, which for many years did a general electrical supply business, and was succeeded by Jones & Gross, in which firm the son, Mr. James Jones, Jr., is now partner.

## *Trade Publications.*

CENTRAL ELECTRIC CIRCULARS.—The Central Electric Company, Chicago, Ill., has issued a new circular describing the Badger portable electric lamp, for which a number of advantages are claimed. Another circular describes new types of lightning arresters for high and low-tension direct and alternating current, and a 16-page circular is devoted to luminous and air radiators.

## Business Notes.

MURALT & COMPANY have opened a branch office in the Temple Court Building, corner Bay and Richmond Streets, Toronto, Ontario. Mr. J. Engh, who has been prominently connected with this company for many years, will be in charge as manager.

MR. H. B. LOGAN, president of Dossert & Company, of New York, who is making an extended trip throughout the West, reports that he has concluded arrangements with Messrs. Otis & Squires, 155 New Montgomery Street, San Francisco, to act as Pacific Coast managers for Dossert & Company. Messrs. Otis & Squires will carry in stock a complete line of Dossert solderless connectors, cable taps and terminals.

THE CHICAGO ELECTRIC METER COMPANY, which was organized one year ago to manufacture the Chicago printing attachment for watt-hour meters, has removed its office and temporary shop from 121 La Salle Street to more spacious quarters at 281 West Van Buren Street, Chicago. Here, with largely increased facilities, the company will be able to supply the growing demand for its devices, which are coming into extended use in the sale of electricity for industrial purposes. Mr. F. F. Kinney is the general manager of the Chicago Electric Meter Company.

WESTINGHOUSE RAILWAY LINE MATERIAL CONTRACTS.—The Westinghouse Electric & Manufacturing Company has received a contract from the Falkenau Electrical Construction Company, of Chicago, engineers for the Salt Lake & Ogden Railway Company, covering direct suspension line material for the 37 miles of electrification of the present steam road between Salt Lake City and Ogden. A contract has also been closed covering the line material for the Gallatin Valley Electric Railway Company, of Bozeman, Mont., for 18 miles of new line; and an order entered from the Long Island Railroad covering 12 miles of low-voltage catenary construction.

INDEPENDENT ELECTRIC MACHINERY COMPANY.—Mr. John E. Launder, who has been associated with the B-R Electric & Telephone Manufacturing Company, of Kansas City, Mo., for the past eight years as purchasing agent and later as city sales manager, has resigned, to associate himself with the Independent Electric Machinery Company, having purchased an active interest in that corporation. The officers of the latter company are now: E. R. Royer, president; R. B. Coleman, vice-president, and J. E. Launder, secretary and treasurer. This company is now located in its own building, at 318-320 South Boulevard, where it has double the former stock and four times the former floor space. A full line of new generators, motors and transformers will be carried, besides the usual stock of second-hand generators, motors and transformers. The repair shop will also be a special feature of benefit to the Southwest trade.

ALLIS-CHALMERS PACIFIC COAST OFFICES.—The Los Angeles office of Allis-Chalmers Company has been moved from the Citizens' National Bank Building to larger and more convenient quarters at 129 East Fifth Street. The constantly increasing demand for the company's products on the Pacific Coast has compelled this change and necessitated an increase in the selling force, particularly in the steam and mining lines. Mr. J. F. Perry is district manager of the company at this office, and Mr. E. H. Knepper, formerly with Ingersoll-Rand Company, has become identified with Allis-Chalmers Company's Los Angeles office in the capacity of salesman. The increased demand for mining and crushing machinery, steam and electrical apparatus, hydraulic turbines, gas engines and steam turbines has also necessitated a larger selling force at the San Francisco office of Allis-Chalmers Company at 599 Mission Street.

## DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Lloyd Lyon, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 24-27, 1909.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, Niagara Falls, Canada, May 6, 7 and 8, 1909.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Hot Springs, Ark., May 13, 14 and 15, 1909.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, 557 Frick Building Annex, Pittsburgh, Pa. Next meeting, June, 1909.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Detroit, June 23, 24 and 25, 1909.

AMERICAN STREET & INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, John S. Corning, Boston Electric Railway Company, Boston.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

ASSOCIATION OF CAR LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next meeting, Chicago, Oct. 5, 6, 7 and 8, 1909.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, S. E. Mumford, Detroit, Mich.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAYA ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, September, 1909.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 204 Dearborn St., Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 500 Fifth Ave., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meetings, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., 1909.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., Eng.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Wichita, Kan., October, 1909.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October, each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Electrical Association. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss. Next meeting, Jackson, Miss., June 15, 1909.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York. Next meeting, Atlantic City, N. J., first week in June, 1909.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Toledo, Ohio, July 21, 1909.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, Boston, Mass., June 10, 1909.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings second and fourth Tuesday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting, Seattle, September, 1909.

Northwestern Electrical Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Canton, Ohio, May 21 and 22, 1909.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Galen Crow, Guthrie, Okla.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., 1909.

Pacific Coast Electric Automobile Association. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

Society of Wireless Telegraph Engineers. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday of each month.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, J. A. Myler, Jr., 609 Juanita Building, Dallas, Tex. Next meeting, Dallas, Tex., May, 1909.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, care of J. G. White & Co., New York.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester, Vt.

Underwriters' National Electrical Association. Secretary, Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., October, 1909.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wisconsin Electric & Interurban Railway Association. Secretary, Dudley Montgomery, Madison, Wis.

# Weekly Record of Electrical Patents

## UNITED STATES PATENTS ISSUED APRIL 27, 1909.

[Conducted by Wm. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

919,302. MOTOR-CONTROL SYSTEM; A. H. Armstrong, Schenectady, N. Y. App. filed July 21, 1906. For electric railways in which an induction motor acts as a braking generator by interposing between the motor and the source a motor-generator, the motor field of which is excited by alternating current, and then varying the frequency in accordance with variations in the speed of the braking generator.

919,338. TRANSFORMER; J. J. Frank, Schenectady, N. Y. App. filed Dec. 17, 1907. Of the core type for polyphase circuits in which primary and secondary windings surround certain of the legs of the core and suitable connections connect on current sources of various phases.

919,350. CLAMPING AND HEATING DEVICE; A. B. Herrick, Cleveland, Ohio. App. filed Nov. 25, 1904. For clamping and heating a rail bond in which a flexible conductor is flexed and a high resistance medium is mounted on the free end.

919,364. HEATING SYSTEM; H. Lemp and W. G. Fisher, Lynn, Mass. App. filed Nov. 17, 1906. For electric locomotives in which a tubular heating coil has a current of electricity flowing through the walls and means for forcing liquid into the interior of the coil.

919,365. HEATING SYSTEM; H. Lemp, Lynn, Mass. App. filed July 1, 1908. For heating railway cars where electricity supplies the heat in which a boiler has a heating coil, the latter supplied with electric current and a meter controls the current.

919,366. HEATING SYSTEM; H. Lemp, Lynn, Mass. App. filed July 2, 1908. For electric locomotives; in which the heater has a coil with electricity flowing through the walls thereof to heat a liquid contained therein.

919,381. ELECTRIC GLOW LAMP; H. Remane, E. Hurwitz, Berlin, and E. Gottschalk, Charlottenburg, Germany. App. filed July 18, 1907. For tungsten filaments attached to the melted ends of supports, the latter containing an alloy of copper and nickel, which produces a fused joint that will not break.

919,384. TELEPHONE SWITCHBOARD CABLE; W. L. Runzel, Chicago, Ill. App. filed March 8, 1907. Consists of a plurality of cable units with their axes in a plane, an inclosing sheath, the opposite walls of the sheath sewed together and a separator through which the stitches pass.

919,385. BURGLAR ALARM FOR SUIT CASES, SATCHELS, ETC.; A. T. Ruthven, Topeka, Kan. App. filed Jan. 14, 1908. When the satchel is picked up a movable circuit-maker closes an alarm circuit.

919,386. INSULATOR; F. Schaub, Jersey City, N. J. App. filed Jan. 11, 1908. Has a base with a removable cap, with curved grooves in the parts to receive the wire.

919,394. TELEPHONE JACK BOX; J. B. Taylor and W. S. Bralley, Schenectady, N. Y. App. filed Aug. 14, 1908. Portable telephone set with flexible conductor and jacks for the train crews of electric railways, with a protective device connected with the line only when the jack is inserted in the box.

919,402. ELECTRICAL HEATING APPARATUS; W. E. Trumpler, Zurich, Switzerland. App. filed Feb. 25, 1907. A woven fabric with the woof of textile and the warp of heating wires.

919,403. APPARATUS FOR PRODUCTION OF OZONE; A. Vosmaer, Philadelphia, Pa. App. filed Oct. 22, 1907. A casing through which the air passes and a plurality of units in the casing each consisting of a rod having a tubular discharger. Details.

919,409. CLEAR-OUT SYSTEM FOR TELEPHONE SWITCHBOARDS; K. Weman and T. S. Hemenway, Buffalo, N. Y. App. filed May 29, 1908. To prevent ringing other parties when the disconnect signal is given by means of an electromagnet of high resistance connected across the cord circuit, a signal coil of lower resistance connectable across the cord circuit and a switch controlled by the magnet for connecting the signal coil across the circuit.

919,411. ELECTRICAL APPARATUS FOR WORKING PLANING MACHINES AND OTHER RECIPROCATING TOOLS; A. D. Williamson, Sheffield, England. App. filed Dec. 11, 1908. For producing a slow cutting stroke and quick return by means of a reversible variable speed electric motor and suitable switches.

919,423. LOCK SWITCH FOR ELECTRIC METERS; William S. Cord, Oceanpark, and H. F. Heywood, Los Angeles, Cal. App. filed Sept. 16, 1908. The current can be locked on or off by means within the meter casing. A switch is within the case and a fixed part on the meter and a key locks the switch to the fixed part in either closed or open position of the switch.

919,445. OZONIZER; A. Lohman, Philadelphia, Pa. App. filed Jan. 20, 1909. With micanite dielectrics. The ozonizer has a casing divided into a water chamber and end air chambers and a micanite dielectric is arranged in the tube which communicates with the air chambers.

919,449. TROLLEY; J. T. Minahan, Philadelphia, Pa. App. filed Oct. 27, 1908. A trolley guard to steer the wheel onto the wire and provided with an auxiliary wheel to contact with the wire when the trolley is almost horizontal.

919,450. THREE-POSITION SIGNAL; W. V. Moak, Schenectady, N. Y. App. filed Sept. 25, 1908. An electric motor with a member driven thereby and means for clutching the member to the semaphore arm to drive it from danger to caution with an electrical magnet controlling the member whose strength is increased above normal for stopping the arm before it reaches danger position in moving from clear to caution.

919,457. GALVANIC CELL; H. P. R. L. Porscke, Hamburg, Germany. App. filed July 15, 1907. Chlorid of iron is the depolarizer mixed with an acid of the arabin group.

919,458. FIELD POLE FOR DYNAMO-ELECTRIC MACHINES; H. Poth, Brooklyn, N. Y. App. filed March 9, 1906. For doing away with the cross magnetizing effect of the armature. By providing a pole piece secured to the leading horn side with an air space between itself and the pole and iron paths briding the air space.

919,460. ELECTRICAL CLUTCH MACHINE; W. T. Price, Buffalo, N. Y. App. filed Nov. 20, 1907. An induction type of clutch having a field magnet, a motor of magnetic material covered with electrical conducting material and revolubly mounted with respect to the magnet.

919,463. ELECTRIC CONTROLLING MEANS; C. S. Reno, Cincinnati, Ohio. App. filed Dec. 12, 1907. A source of energy, a translating device, compensating windings and a controlling switch having protective devices.

919,472. ELECTRICAL SWITCH; T. W. Sanford, Chicago, Ill. App. filed July 24, 1908. A two-push button switch actuated by a spring, each plunger carrying the push button having an abutment flange and two stops rigid with the switchblade carrying member to engage the flange.

919,473. COMBINED SWITCH AND CUTOUT; H. R. Sargent, Schenectady, N. Y. App. filed Dec. 1, 1902. For street car lighting, having a rotary switch and inclosed fused contacts.

919,474. INCANDESCENT LAMP; H. R. Sargent, Schenectady, N Y. App. filed Aug. 1, 1904. A socket having an insulating base with a central chamber and side recesses and divided into sections.

919,489. ELECTRIC HEATER; G. E. Stevens, Lynn, Mass. App. filed Nov. 29, 1907. For heating air, particularly for foot warmers, comprising a box with a pivoted apertured top and an electric heater distributing heat throughout the area of the top.

919,491. AUTOMATIC TRUNKING APPARATUS FOR ELECTRICAL CIRCUITS; L. O. Surles, Atlanta, Ga. App. filed June 30, 1906. For automatic trunking between exchanges. Details.

919,495. INDICATOR AND ADVERTISER; C. H. Townsend, Berkeley, Cal. App. filed Dec. 23, 1907. A display sign driven by an electric motor.

919,510. EDGEWISE WINDING MACHINE; J. J. Wood, Fort Wayne, Ind. App. filed Oct. 2, 1907. A rotary winding machine for winding ribbon edgewise.

919,511. DYNAMO-ELECTRIC MACHINE; J. J. Wood, Fort Wayne, Ind. App. filed Nov. 22, 1907. For the fields of dynamo-electric machines to avoid the danger of centrifugal force in which the spider has pole pieces having indentations and a retaining piece fits into the indentations to clamp the pole pieces to the spider.

919,514. ELECTRIC MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 12, 1907. Electric motors of the commutator type for direct and alternating currents, to be used on electric railways. The field coils are connected to produce a field on direct current and a portion of the coils produce a commutating field for alternating-current operation.

919,516. PANEL BOARD FOR ELECTRIC POWER DISTRIBUTION; M. E. Ames, Chicago, Ill. App. filed Oct. 21, 1908. A number of users are supplied from a single source and the supply is metered.

919,519. TELEPHONE CUTOUT AND LIGHTNING ARRESTER; W. E. Ashby, Chariton, Ia. App. filed Feb. 18, 1908. A plurality of telephones can be connected through the cutout with the same circuit of line wires. The lightning arrester includes two pairs of combs.

919,523. ELECTRIC MOTOR; R. E. Barker, Lynn, Mass. App. filed Oct. 14, 1907. Single-phase induction motor with a single centrifugal device with connections to a controlling switch and clutch to automatically operate both .

919,524. INDUCTION MOTOR; H. L. Barnholdt, Pittsfield, Mass. App. filed Oct. 31, 1907. Squirrel-cage motor in which the end rings are split with means for closing the split portions automatcially by centrifugal force when at speed.

919,527. INDUCTION MOTOR; S. R. Bergman, Lynn, Mass. App. filed Oct. 21, 1905. Squirrel-cage motor with two windings, one of low and the other of high resistance, one for starting and the other for use at speed.

919,535. AUTOMATICALLY OPERATED ELECTRIC SWITCH; J. C. Calhoun, Holland, Mich. App. filed Sept. 17, 1906. A rock shaft carrying two contacts with mercury cups into which the contacts alternately dip.

919,537. INDUCTION MOTOR CONTROL; F. E. Case, Schenectady, N. Y. App. filed July 8, 1908. Adds impedances in the primary circuit with short circuiting switches to cut them in and out as the several sections of the secondary impedances are short circuited.

919,547. DYNAMO-ELECTRIC MACHINE; W. F. Dawson, Rugby, England. App. filed July 15, 1908. Current-collecting and short-circuiting devices for induction motors with coil-wound motors.

919,563. SUBMERGED FUSE; C. E. Eveleth, Schenectady, N. Y. App. filed May 4, 1905. A tank, a liquid therein, a fuse in the liquid, and a baffle plate providing a tank, with apertures through which the fuse passes.

919,569. LIGHTNING ARRESTER; W. Gifford, Traverse City, Mich. App. filed March 25, 1908. A bank of high-resistance conductors each in series with an air gap.

919,571. CLAMPING EAR FOR TROLLEY WIRES; F. Guillot, Schenectady N. Y. App. filed Oct. 10, 1907. The ear comprises two jaws which slide in a holder in which they have a bearing so that when spread apart by a wedge the lower edges engage the sides of the trolley wire.

919,573. CONTROL OF RAILWAY APPARATUS; L. A. Hawkins, Schnectady, N. Y. App. filed July 16, 1908. Track switches, driven by electric motors, with a magnetic clutch for connecting the motor to the switch.

919,575. RHEOSTAT; H. E. Heath, Lynn, Mass. App. filed Aug. 4, 1905. A resistance unit of cast silicon provided with a contacting terminal.

919,577. RAIL BOND; G. H. Hill, Schenectady, N. Y. App. filed Dec. 19, 1907. A laminated body, a sheet metal cap enclosing an end and having a perforated base and a rib integral with the base and extending between two of the laminations.

919,578. RELAY; G. H. Hill, Schenectady, N. Y. App. filed Sept. 28, 1908. A relay for railway work in which when the relay is tipped over by accident a ball comes out of a cup and moves the armature to the position to which it is normally moved by gravity.

919,584. VAPOR ELECTRIC DEVICE; P. A. Huguenin, Paris, France. App. filed Nov. 21, 1907. A mercury vapor device, inclined and pivoted, with a solenoid to move the device to the opposite side of the horizontal and a cutout for the solenoid.

919,593. DENTAL ENGINE; M. Kelly, Hammond, Ind. App. filed April 25, 1908. Means for attaching an electric engine to a suspended cable and for connecting the tool with the motor.

919,604. DYNAMO-ELECTRIC MACHINE; H. Lippelt, Lynn, Mass. App. filed Feb. 3, 1908. Has a multipolar field, an open coil armature, the field magnet having main poles unevenly spaced with respect to the armature, and having shunt and series windings, together with series wound auxiliary commutating poles occupying the spaces.

919,626. COLLECTOR RING; J. E. Noeggerath, Schenectady, N. Y. App. filed Nov. 26, 1907. For acyclic generators run at high speeds in which a collector shell carries collector rings having feet with elastic tapering side portions, so that expansion of the rings does not produce undue strains.

919,633. DISTRIBUTION SYSTEM; F. W. Peek, Jr., Schenectady, N. Y. App. filed Dec. 14, 1908. For distributing the load on generators having regulators of the Tirrill type. The voltage regulator contains a differentially wound magnet, one winding varying with the voltage of its own generator and the other with the load on the other generator.

919,646. TRANSMITTER FOR IMPULSE-DRIVEN CLOCK SYSTEMS; F. M. Schmidt, Brooklyn, N. Y. App. filed Nov. 5, 1908. For synchronizing clock systems controlling secondary clock from a master clock. Details.

919,647. FEED AND POSITIVE LOCK FOR CLOCK TRAINS; F. M. Schmidt, Brooklyn, N. Y. App. filed Nov. 5, 1908. For moving clock trains step by step. Details.

919,662. REGISTER FOR TELEPHONES. W. O. Weissich, San Francisco, Cal. App. filed Dec. 29, 1906. For registering calls and the tolls due in which a plunger is operated by the subscriber, a lock prevents the movement thereof, a magnet releases the lock, the magnet being controlled by central.

919,670. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed Aug. 3, 1906. Uses both alternating and direct currents and a converter for transforming either kind to the other. Controls the division of the load between two sources of alternating current independent of any changes of speed of the rotary converter.

919,672. SOLENOID; C. J. Anderson, Chicago, Ill. App. filed Oct. 16, 1908. Avoids the humming noise produced when the alternating-current solenoid is used by providing a member of magnetic material movable in an opening of the pole piece which is yieldingly supported in the opening.

919,691. ELECTRICALLY ILLUMINATED DRINKING GLASS; J. H. Cahill, St. James, N. Y. App. filed Nov. 23, 1908. A drinking glass with a sub-base having an electric battery and an electric lamp.

919,696. INDIVIDUAL PROTECTOR; F. B. Cook, Chicago, Ill. App. filed June 10, 1908. A fuse for telephones, having an iron core and a copper sheath surrounding the iron core with a crimped fuse wire extending through the bore so that a definite portion of the wire touches the sides of the bore.

919,702. FIRE-ALARM BOX ATTACHMENT; F. A. Dorsey and M. E. Keyser, Baltimore, Md. App. filed June 16, 1908. Ascertains the person actuating the alarm by automatically applying a handcuff to the operator, which can only be unlocked by a key carried by the fireman.

919,724. ELECTROLYTIC METER; G. Hookham and S. H. Holden, Birmingham, England. App. filed June 1, 1908. The meter has a storage of gas and an anode capable of absorbing the gas, together with a measuring tube.

919,744. ELECTRIC FUSE CASE; T. E. Murray, New York, N. Y. App. filed Sept. 28, 1908. A tubular fuse case with a disk-shaped cover, with means for locking the cover in place.

919,763. TROLLEY WIRE SUPPORT; J. W. Porter, Chicago, Ill. App. filed Nov. 16, 1907. Separable clamping members clutch the trolley wire and are provided with tongues and slots forming the securing and locking means instead of bolts.

919,790. SECONDARY ELECTRIC CLOCK; J. Steiger and J. Besancon, La Chauz-De-Fonds, Switzerland. App. filed July 7, 1908. A rotary electric motor has a lost motion connection with the pallet actuating the hand operating wheel.

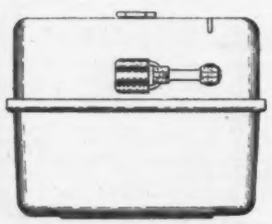
919,803. MAXIMUM TRACTION TRUCK; W. S. Adams, Philadelphia, Pa. App. filed June 20, 1908. Improvements in trucks for cars.

919,811. ELECTRICAL SWITCH; H. A. Beynon, Chicago, Ill. App. filed May 11, 1907. For automatically switching on an electric light for bookkeepers in which the switch is closed by a platform on which the bookkeeper stands.

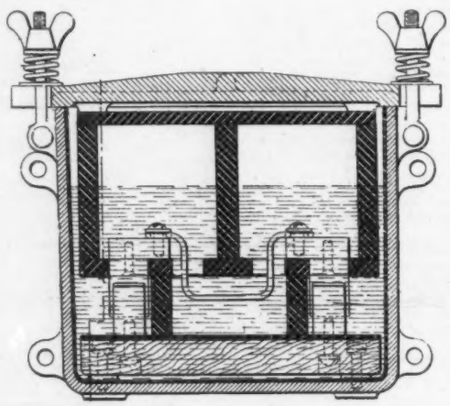
919,812. TELEPHONE APPARATUS; C. E. Bilton, Bridgeport, Conn. App. filed July 28, 1908. A telephone case of sheet metal having a back plate with ears and the central portion of the front stamped outward to form a pocket to receive a diaphragm.

919,821. INCANDESCENT ELECTRIC LIGHT; W. J. Carpenter and T. F. McDermott, Providence, R. I. App. filed Aug. 16, 1907. Improvement in the bulb and socket for electric lights. Details.

919,830. TERMINAL FOR ELECTRIC CABLES; C. W. Davis, Edgeworth, Pa. App. filed June 5, 1907. A terminal having a plug and a case, said plug consisting of a core and a surrounding body of insulating material in moisture-tight contact therewith and having a flaring leakage preventing petticoat.



919,423—Lock Switch for Electric Meters.



919,563—Submerged Fuse.

919,843. ELECTRIC HEATER; W. C. Fish, Lynn, Mass. App. filed Jan. 13, 1906. A heating base for receiving various utensils having a smooth tapering surface into which the receptacles fit.

919,862. SQUIRREL-CAGE ROTOR FOR ELECTRIC MOTORS; E. Heitmann, Montclair, N. J. App. filed July 15, 1908. The core is laminated and the conductor bars have transverse slots with coils engaging the slots and electrically connecting the bars.

919,900. PRIMARY ELECTRIC BATTERY; G. A. Lutz, Plainfield, N. J. App. filed Dec. 12, 1908. The depolarizer is a plate of cupric oxide, the positive electrode is zinc. An insulating block supports a frame which carries the depolarizing plate.

919,908. ELECTRICAL RESISTANCE DEVICE; H. S. Martin, Liverpool, England. App. filed July 13, 1908. A compression resistance body consisting of a mixture of mica in the form of scales with powdered graphite and sand.

919,940. OUTLET FIXTURE FOR CONDUITS; H. T. Paiste, Philadelphia, Pa. App. filed March 18, 1908. A fixture consisting of a hollow structure having a plurality of openings, a lamp socket mounted over one of said openings, another opening having its inner end threaded and its outer portion unthreaded, a conduit engaging the unthreaded portion.

919,968. TROLLEY WHEEL BEARING; A. C. Sloan, Salamanca, N. Y. App. filed Aug. 28, 1908. A lubricating device surrounds the axle which is made tubular to receive the device.

919,994. ELECTRIC SWITCH; G. Wright, Pittsfield, Mass. App. filed Aug. 3, 1905. Automatically indicates the different positions of the switch. The indicator is mechanically connected with the locking mechanism for the switch to show when the switch is opened.

919,996. ELECTRIC SIGNALING SYSTEM; S. M. Young and F. Townsend, New York, N. Y. App. filed Sept. 2, 1908. Automatic block system for electric railways supplied with high-frequency, alternating current connected at intervals across the rails.

919,998. STARTING RHEOSTAT; P. H. Zimmer, Schenectady, N. Y. App. filed Dec. 26, 1907. A starting rheostat comprising a resistance varying arm, a plurality of independently actuated switches in series therewith, and means whereby said switches are closed by an initial movement of said arm.

920,005. PLUG FUSE; H. U. Badeau and F. P. Poole, Bridgeport, Conn. App. filed Dec. 19, 1908. A cup-shaped porcelain body with terminals and within it a flat fuse strip having a reduced cross section for the melting point.

920,024. ELECTRIC CLOCK; E. E. Clement, Washington, D. C. App. filed Dec. 2, 1905. Avoids the use of moving parts upon the dial, the indicating devices arranged in groups representing hours and minutes with means for operating each device in chronometric order.

920,030. SWITCH SIGNAL; R. B. Cunningham, Chicago, Ill. App. filed Oct. 8, 1908. A railroad track switch having an alarm bell which rings when the switch is open.

920,032. ELECTRIC SWITCH; C. W. Denny, Middletown, Ohio. App. filed Aug. 3, 1908. For starting alternating motors. A double-throw switch having a plurality of switch blades with a protective device for overloads.

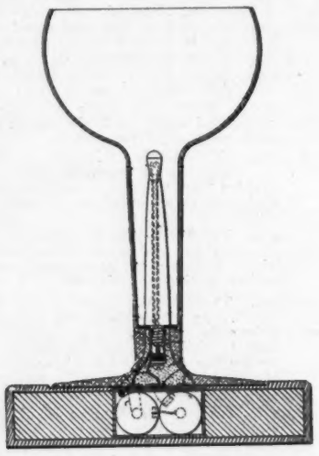
920,034. TELEGRAPHIC TRANSMITTER; P. Dinger, Cleveland, Ohio. App. filed July 25, 1907. The main vibrator has a fixed weight with a stem and contact adjusting device connected with the key under spring tension so as to impart acceleration to the vibrator for making sharp dots.

920,036. RELAY; F. L. Dodgson, Buffalo, N. Y. App. filed Nov. 3, 1908. A polarized relay for railway signaling having permanent magnets surrounding the three sides of the pole piece so that the magnetic effect of all poles tends to rotate them in the same direction.

920,040. SINGLE-PHASE MOTOR; F. Eichberg, Berlin, Germany. App. filed May 22, 1909. Of the commutator type having an inducing winding on the stator and an armature winding with commutator. Main brushes short circuit the rotor on the line of magnetization of the inducing winding, and exciting brushes magnetize at an angle to said line with means for introducing into the circuit of the main brushes a shunt voltage assisting the voltage produced by the inducing winding.

920,043. TELEPHONE PARTY LINE SWITCHING APPARATUS; A. J. Farmer, Detroit, Mich. App. filed April 19, 1905. For selectively connecting and calling the station, effecting the proper sequence of signals at the exchange, and automatically restoring the selective apparatus. A controlling magnet and armature is controlled by a relay which is in multiple with its actuated contact, and a normally open contact and a contact closed only during the movement of the armature are provided for the purpose.

920,045. TIME-LIMIT CIRCUIT BREAKER; W. Fellenberg, Charlottenburg, Germany. App. filed Aug. 29, 1907. Opens in circuit after an abnormal current has persisted for a predetermined length of time by means of thermostatic strips.



919,691—Electrically Illuminated Drinking Glass.

920,052. TURBO-GENERATOR; B. H. Hamilton and W. E. Ver Planck, Lynn, Mass. App. filed April 19, 1907. The turbine and dynamo have a casing permitting circulation of air and discharging the air over the current-collecting devices.

920,073. APPLICATION AND DISTRIBUTION OF ELECTRIC MOTIVE POWER, PARTICULARLY FOR USE IN STARTING MACHINERY AND FOR SIMILAR PURPOSES; G. W. Mascord, London, England. App. filed April 9, 1906. An electric motor has a slow-speed positive clutch and a high speed between the motor and the driven shaft with hand means for operating the clutches.

920,078. ELECTRICAL FURNACE; H. Nathusius, Friedenshutte, near Morgenroth, Germany. App. filed Aug. 25, 1908. For refining steel by means of a hearth, a cover having slots, electrodes guided by the slots and additional electrodes passing the current through the material on the hearth.

920,084. RECORDING INSTRUMENT; W. H. Pratt, Lynn, Mass. App. filed Aug. 10, 1907. The movable coil is mounted on a stretched wire with two flexible filaments for sustaining its weight.

920,097. NEUTRALIZING INDUCTIVE DISTURBANCES; J. B. Taylor, Schenectady, N. Y. App. filed Nov. 20, 1907. For avoiding induction by electric railways on telephone lines by means of a transformer having one coil in series with the conductor carrying the inducing current, the other coil being inserted with the other conductor and a resistance in circuit with said last-named coil.

920,103. BATTERY CHARGING APPARATUS; F. E. Case, Schenectady, N. Y. App. filed Nov. 25, 1908. Automatic means for connecting and disconnecting the battery from its source, together with means operative when the battery is disconnected for interrupting the operation of the automatically operated switch.

12,946 (REISSUE). PREPARATION OF THE INDIGO VAT EMPLOYED IN DYEING; Henri Chaumat, Paris, France. App. filed Oct. 8, 1908. Electrolytic process in which the bath of alkaline salt is protected from air and in which the cathode consists of powdered indigo blue mixed with graphite.

12,947 (REISSUE). STARTER FOR ELECTRIC MOTORS; W. C. O'Brien, Baltimore, Md. App. filed March 24, 1909. Two solenoids control a plurality of switch levers.

12,950 (REISSUE). ELECTROMAGNETIC TRACTION DEVICE AND EMERGENCY BRAKE; C. A. Wells, Chicago, Ill. App. filed Sept. 27, 1906. Increases the traction between the wheels and the rails by magnetizing the wheels and using a magnetizable shoe which may be thrown into contact with the rail.